UTAH

State Implementation Plan

Control Measures for Area and Point Sources, Fine Particulate Matter, $PM_{2.5}$ SIP for the Salt Lake City, UT Nonattainment Area

Section IX. Part A.21

Adopted by the Utah Air Quality Board

December XX 2012

Acronyms

BACT	Best Available Control Technology
CAA	Clean Air Act
CFR	Code of Federal Regulations
CMAQ	Community Multiscale air Quality
CTG	Control Techniques Guideline documents
DAQ	Utah Division of Air Quality (also UDAQ)
EPA	Environmental Protection Agency
FRM	Federal Reference Method
MACT	Maximum Available Control Technology
MATS	Model Attainment Test Software
MPO	Metropolitan Planning Organization
$\mu g/m^3$	Micrograms Per Cubic Meter
Micron	One Millionth of a Meter
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NH_3	Ammonia
NO_x	Nitrogen Oxides
NSPS	New Source Performance Standard
NSR	New Source Review
PM	Particulate Matter
PM_{10}	Particulate Matter Smaller Than 10 Microns in Diameter
$PM_{2.5}$	Particulate Matter Smaller Than 2.5 Microns in Diameter

1	RACM	Reasonably Available Control Measures
2	RACT	Reasonably Available Control Technology
3	RFP	Reasonable Further Progress
4	SIP	State Implementation Plan
5	SMOKE	Sparse Matrix Operator Kernal Emissions
6	SO_2	Sulfur Dioxide
7	SO_x	Sulfur Oxides
8	TSD	Technical Support Document
9	VOC	Volatile Organic Compounds
10	UAC	Utah Administrative Code
11	WRF	Weather Research and Forecasting

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Chapter 1 – INTRODUCTION AND BACKGROUND

1.1 Fine Particulate Matter

According to EPA's website, particulate matter, or PM, is a complex mixture of extremely small particles and liquid droplets. Particulate matter is made up of a number of components, including acids (such as nitrates and sulfates), organic chemicals, metals, and soil or dust particles.

The size of particles is directly linked to their potential for causing health problems. EPA is concerned about particles that are 10 micrometers in diameter or smaller because those are the particles that generally pass through the throat and nose and enter the lungs. Once inhaled, these particles can affect the heart and lungs and cause serious health effects. Other negative effects are reduced visibility and accelerated deterioration of buildings.

EPA groups particle pollution into two categories:

- "Inhalable coarse particles," such as those found near roadways and dusty industries, are larger than 2.5 micrometers and smaller than 10 micrometers in diameter. Utah has previously addressed inhalable coarse particles as part of its PM_{10} SIPs for Salt Lake and Utah Counties, but this fraction is not measured as $PM_{2.5}$ and will not be a subject for this nonattainment SIP.

- "Fine particles," such as those found in smoke and haze, are 2.5 micrometers in diameter and smaller and thus denoted as $PM_{2.5}$. These particles can be directly emitted from sources such as forest fires, or they can form when gases emitted from power plants, industries and automobiles react in the air.

PM concentration is reported in micrograms per cubic meter or $\mu g/m^3$. The particulate is collected on a filter and weighed. This weight is combined with the known amount of air that passed through the filter to determine the concentration in the air.

1.2 Health and Welfare Impacts of $PM_{2.5}$

Numerous scientific studies have linked particle pollution exposure to a variety of problems, including:

- increased respiratory symptoms, such as irritation of the airways, coughing, or difficulty breathing, for example;
- decreased lung function;
- aggravated asthma;
- development of chronic bronchitis;
- irregular heartbeat;
- nonfatal heart attacks; and
- premature death in people with heart or lung disease.

People with heart or lung diseases, children and older adults are the most likely to be affected by particle pollution exposure. However, even if you are healthy, you may experience temporary symptoms from exposure to elevated levels of particle pollution.

1.3 Fine Particulate Matter in Utah

Excluding wind-blown desert dust events, wild land fires, and holiday related fireworks, elevated $PM_{2.5}$ in Utah occurs when stagnant cold pools develop during the winter season.

The synoptic conditions that lead to the formation of cold pools in Utah's nonattainment areas are: synoptic scale ridging, subsidence, light winds, snow cover (often), and cool to cold surface temperatures. These conditions occur during winter months, generally mid-November through early March.

During a winter-time cold pool episode, emissions of $PM_{2.5}$ precursors react quickly to elevate overall concentrations, and of course dispersion is very poor due to the very stable air mass. Episodes may last from a few days to tens of days when meteorological conditions change to once again allow for good mixing.

The scenario described above leads to exceedances and violations of the 24-hour health standard for $PM_{2.5}$. In other parts of the year concentrations are generally low, and even with the high peaks incurred during winter, are well within the annual health standard for $PM_{2.5}$.

1.4 2006 NAAQS for $PM_{2.5}$

In September of 2006, EPA revised the (1997) standards for $PM_{2.5}$. While the annual standard remained unchanged at 15 $\mu g/m^3$, the 24-hr standard was lowered from 65 $\mu g/m^3$ to 35 $\mu g/m^3$.

DAQ has monitored $PM_{2.5}$ since 2000, and found that all areas within the state have been in compliance with the 1997 standards. At this 2006 new level, all or parts of five counties have collected monitoring data that is not in compliance with the 24-hr standard.

1.5 $PM_{2.5}$ Nonattainment Areas in Utah

There are two distinct nonattainment areas for the 2006 $PM_{2.5}$ standards residing entirely within the state of Utah. These are the Salt Lake City, UT, and Provo, UT nonattainment areas, which together encompass what is referred to as the Wasatch Front. A third nonattainment area is more or less geographically defined by the Cache Valley which straddles the border between Utah and Idaho (the Logan, UT – ID nonattainment area.) Figure 1.1 below shows the geographic extent of these areas.

None of these three areas has violated the annual NAAQS for $PM_{2.5}$. Without exception, the exceedances leading to 24-hr NAAQS violations are associated with relatively short-term meteorological occurrences.

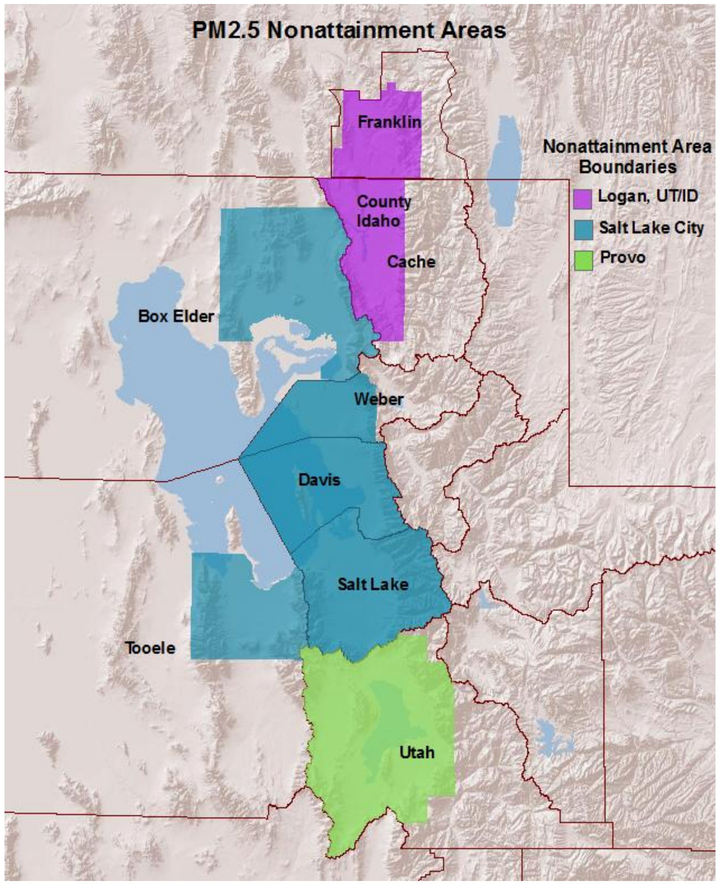

Figure 1.1, Nonattainment Areas for the 2006 $PM_{2.5}$ NAAQS

Each of these three areas was designated, by the EPA, based on the weight of evidence of the following nine factors recommended in its guidance and any other relevant information:

- pollutant emissions
- air quality data
- population density and degree of urbanization
- traffic and commuting patterns
- growth
- meteorology

- geography and topography
- jurisdictional boundaries
- level of control of emissions sources

EPA also used analytical tools and data such as pollution roses, fine particulate composition monitoring data, back trajectory analyses, and the contributing emission score (CES) to evaluate these areas.

While the general meteorological characteristics are identical between the Wasatch Front and Cache Valley, there are two important differences related to topography. First, the Cache Valley is a closed basin while the Wasatch Front has many large outlets that connect it to the larger Great Basin. The large outlets along the Wasatch Front provide the potential for greater advection of pollutants and for a potentially weaker cold pool. Second, the Cache Valley is a narrow (<20 km) valley bordered by extremely steep mountains. These topographical differences lead to faster forming, more intense, and more persistent cold pools in Cache Valley relative to the Wasatch Front.

Because of these differences, the Wasatch Front and Cache Valley are designated as separate nonattainment areas; however, they will be modeled together within the same modeling domain.

1.6 $PM_{2.5}$ Attainment Plan Precursors

The majority of ambient $PM_{2.5}$ collected during a typical cold-pool episode of elevated concentration is secondary particulate matter, born of precursor emissions. The main precursor gasses associated with fine particulate matter are discussed in EPA's Clean Air Particulate Implementation Rule (FR 72, 20586), and there are certain presumptions about each of these concerning how they are to be treated in a given attainment plan. It is important that this plan identify which of these will be evaluated for the purpose of developing control measures.

- Sulfur Dioxide (SO_2) is to be evaluated for control measures in all nonattainment areas. SO_2 is therefore to be considered as a $PM_{2.5}$ attainment plan precursor.

- Oxides of Nitrogen (NO_x) are presumed to be evaluated for control measures in any given nonattainment area, unless it can be demonstrated that it is not a significant contributor to $PM_{2.5}$ concentrations. No such demonstration will be made as part of this plan. Therefore, NO_x will be considered as a $PM_{2.5}$ attainment plan precursor.

- Volatile Organic Compounds (VOC) are presumed not to be evaluated for control measures in any given nonattainment area, unless it can be demonstrated that it is in fact a significant contributor to $PM_{2.5}$ concentrations. The air modeling that underlies this SIP demonstration does in fact indicate that $PM_{2.5}$ concentrations are very sensitive to VOC concentrations. As such, VOC is to be considered a significant contributor to $PM_{2.5}$ concentrations and will be considered as a $PM_{2.5}$ attainment plan precursor. Additional information concerning a demonstration to this effect is included in the Technical Support Document.

1.7 Other $PM_{2.5}$ Precursors – Ammonia

Ammonia (NH_3) is another precursor gasses associated with fine particulate matter. Like VOC, the Clean Air Particulate Implementation Rule presumes that ammonia would not be evaluated for control measures in any given nonattainment area, unless it can be demonstrated that it is in fact a significant contributor to $PM_{2.5}$ concentrations. Most of the secondary particulate matter collected during cold-pool conditions is ammonium nitrate. Still, there is every indication that in each of the airsheds evaluated with the air model there is a large surplus of ammonia relative to what would be required to produce the observed ammonium nitrate. Sensitivity runs with the model indicate that significant reductions in the inventories of ammonia have little to no effect on predicted $PM_{2.5}$ concentrations. It cannot be said that ammonia is a significant contributor to $PM_{2.5}$ concentrations, and therefore ammonia will not be considered as a $PM_{2.5}$ attainment plan precursor.

Chapter 2 – REQUIREMENTS FOR 2006 $PM_{2.5}$ PLAN REVISIONS

2.1 Requirements for Nonattainment SIPs

Section 110 of the Clean Air Act lists the requirements for implementation plans. Many of these requirements speak to the administration of an air program in general. Section 172 of the Act contains the plan requirements for nonattainment areas. Some of the more notable requirements identified in these sections of the Act that pertain to this SIP include:

- Implementation of Reasonably Available Control Measures (RACM) as expeditiously as practicable
- Reasonable Further Progress (RFP) toward attainment of the National Ambient Air Quality Standards by the applicable attainment date
- Enforceable emission limits as well as schedules for compliance
- A comprehensive inventory of actual emissions
- Contingency measures to be undertaken if the area fails to make reasonable further progress or attain the NAAQS by the applicable attainment date

More specific requirements for the preparation, adoption, and submittal of implementation plans are specified in 40 CFR Part 51. Subpart Z of Part 51 contains provisions for Implementation of $PM_{2.5}$ National Ambient Air Quality Standards.

2.2 $PM_{2.5}$ Implementation Rule

Beyond what has been codified in Subpart Z of Part 51 concerning the Implementation of the $PM_{2.5}$ NAAQS, EPA provides additional clarification and guidance in its Clean Air Particulate Implementation Rule for the 1997 $PM_{2.5}$ NAAQS (FR 72, 20586) and its subsequent Implementation Guidance for the 2006 24-Hour Fine Particle NAAQS (March 2, 2012).

2.3 Summary of this SIP Proposal

This implementation plan was developed to meet the requirements specified in the law, rule, and appropriate guidance documents identified above. Discussed in the following chapters are: air monitoring, reasonably available control measures, modeled attainment demonstration, emission inventories, reasonable further progress toward attainment, and contingency measures. Additional information is provided in the technical support document.

Chapter 3 – Ambient Air Quality Data

3.1 Measuring Fine Particle Pollution in the Atmosphere

Utah has monitored $PM_{2.5}$ in its airsheds since 2000 following the promulgation of the 1997 $PM_{2.5}$ NAAQS which was set at 65 µg/m^3. $PM_{2.5}$ monitoring sites were initially located based on concentrations of PM_{10}, which historically were measured at sites located based on emissions of primary particles. $PM_{2.5}$ concentrations, especially during Utah's wintertime valley temperature inversions, tend to be distributed more homogenously within a specific airshed. Homogeneity of $PM_{2.5}$ concentrations supports that one or two monitors are adequate to determine compliance with the NAAQS in specific airsheds. DAQ's monitors are appropriately located to assess concentration, trends, and changes in $PM_{2.5}$ concentrations. During Utah's wintertime cold-pool episodes, every day sampling and real time monitoring are needed for modeling and public notification.

3.2 Utah's Air Monitoring Network

The Air Monitoring Center (AMC) maintains an ambient air monitoring network in Utah that collects both air quality and meteorological data. Figure 3.1 shows the location of sites along the Wasatch Front that collect $PM_{2.5}$ data. Twelve sites collect $PM_{2.5}$ data using the Federal Reference Method (FRM); $PM_{2.5}$ is collected on filters over a 24 hour period and its mass is measured gravimetrically. Seven of those sites also measure $PM_{2.5}$ concentrations continuously in real-time. Real-time $PM_{2.5}$ data is useful both for pollution forecasting and to compare with 24-hour concentrations of $PM_{2.5}$ collected on filters. Of the twelve sites that use the FRM to measure $PM_{2.5}$, six sites collect $PM_{2.5}$ data daily and six sites collect $PM_{2.5}$ data on every third day. Three sites along the Wasatch Front collect speciated $PM_{2.5}$; the particulate matter on the speciated $PM_{2.5}$ filters is analyzed for organic and inorganic carbon and a list of 48 elements. $PM_{2.5}$ speciation data is particularly useful in helping to identify sources of particulate matter. The ambient air quality monitoring network in along Utah's Wasatch Front meets EPA requirements for monitoring networks.

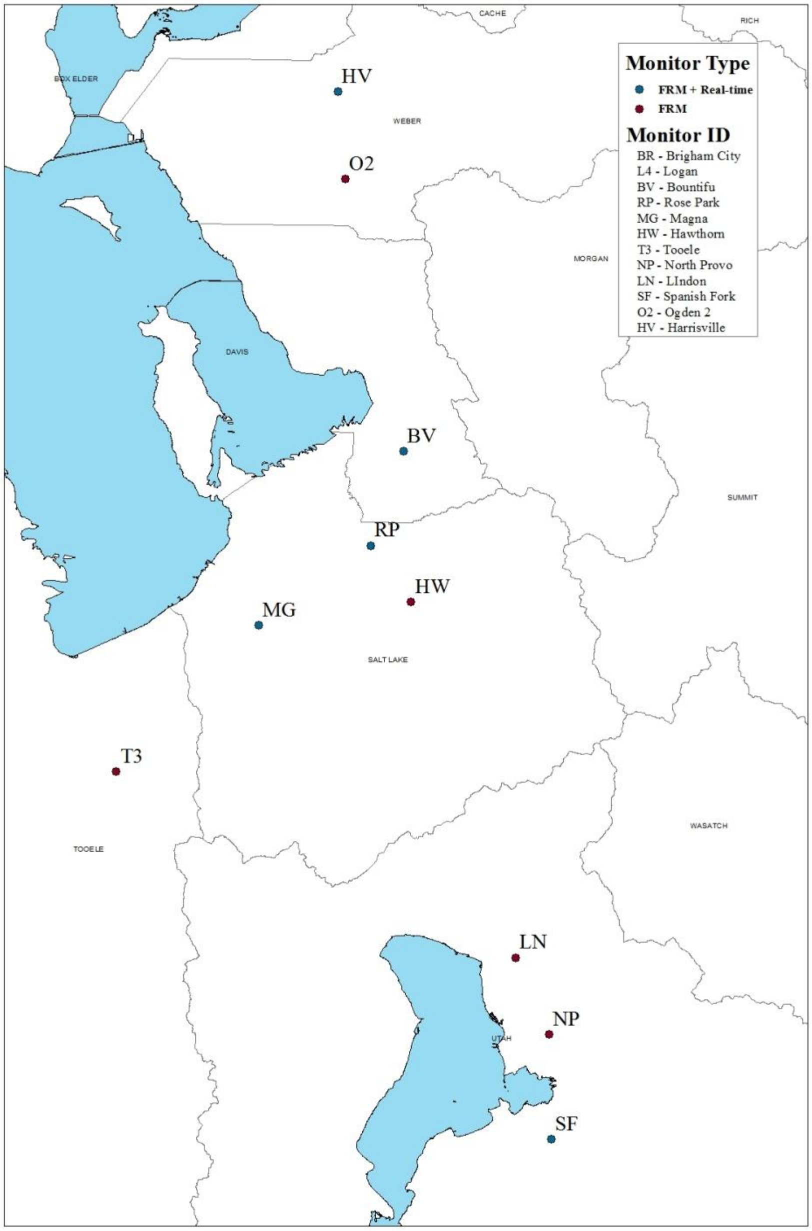

Figure 3.1, Utah's $PM_{2.5}$ Air Monitoring Network

3.3 Annual $PM_{2.5}$ – Mean Concentrations

The procedure for evaluating $PM_{2.5}$ data with respect to the NAAQS is specified in Appendix N to 40 CFR Part 50. Generally speaking, the annual $PM_{2.5}$ standard is met when a three-year average of annual mean values is less than or equal to 15.0 µg/m^3. Each annual mean is itself an average of four quarterly averages.

Table 3.1, below shows the running 3-year averages of annual mean values for each of Utah's monitoring locations. It can be seen from the data that there are no locations at which the annual NAAQS has been violated.

		3-Year Average of Annual Mean Concentrations					
Location	**County**	**04 - 06**	**05 - 07**	**06 - 08**	**07 - 09**	**08 - 10**	**09 - 11**
Logan (Combined POC 1 & 2)	Cache	12.2	10.3	9.2	9.8	10.0	9.7
Brigham City	Box Elder	8.7	8.2	8.2	8.4	8.3	8.2
Ogden 2 (POC 1)	Weber	11.4	10.6	10.4	10.6	9.7	9.5
Harrisville	Weber	9.5	9.1	8.9	9.2	8.6	8.3
Bountiful	Davis	10.6	10.0	10.1	10.6	9.8	9.2
Rose Park (POC 1)	Salt Lake				10.7	10.4	9.7
Magna	Salt Lake	9.6	8.9	8.4	8.7	8.5	8.4
Hawthorn (POC 1)	Salt Lake	11.6	10.7	10.5	10.9	10.4	9.7
Tooele	Tooele	7.8	7.6	6.7	7.0	6.8	6.8
Lindon (POC 1)	Utah	10.7	10.4	10.4	10.7	9.8	9.1
North Provo	Utah	10.0	10.0	10.0	10.2	9.4	8.7
Spanish Fork	Utah	8.7	8.9	9.0	9.6	8.8	8.5

Table 3.1, $PM_{2.5}$ Annual Mean Concentrations

3.4 Daily $PM_{2.5}$ – Averages of 98^{th} Percentiles and Design Values

The procedure for evaluating $PM_{2.5}$ data with respect to the NAAQS is specified in Appendix N to 40 CFR Part 50. Generally speaking, the 24-hr. $PM_{2.5}$ standard is met when a three-year average of 98^{th} percentile values is less than or equal to 35 µg/m^3. Each year's 98^{th} percentile is the daily value below which 98% of all daily values fall.

Table 3.2, below shows the running 3-year averages of 98^{th} percentile values for each of Utah's monitoring locations. It can be seen from the data that there are many locations at which the 24-hr. NAAQS has been violated, and this SIP has been structured to specifically address the 24-hr. standard.

Site-Specific Baseline Design Values:								
		3-Year Average of 98th Percentiles						Baseline Design Value
Location	**County**	**04 - 06**	**05 - 07**	**06 - 08**	**07 - 09**	**08 - 10**	**09 - 11**	
Logan (Combined POC 1 & 2)	Cache	64	42	36	40	43	42	**39.5**
Brigham City	Box Elder	35	29	35	37	42	40	**38.2**
Ogden 2 (POC 1)	Weber	40	36	36	40	37	41	**37.6**
Harrisville	Weber	38	35	35	38	36		**36**
Bountiful	Davis	38	38	35	38	38	40	**37.0**
Rose Park (POC 1)	Salt Lake				37	41	41	**39.2**
Magna	Salt Lake	40	32	29	31	33	35	**30.8**
Hawthorn (POC 1)	Salt Lake	48	48	46	48	44	45	**45.9**
Tooele	Tooele	23	31	22	23	26	27	**23.6**
Lindon (POC 1)	Utah	44	45	44	50	41	41	**44.9**
North Provo	Utah	38	37	37	42	36	35	**38.4**
Spanish Fork	Utah	36	36	34	42	39	42	**38.4**

Table 3.2, 24-hour $PM_{2.5}$ Monitored Design Values

As mentioned in the forgoing paragraph, this SIP is structured to address the 24-hr. $PM_{2.5}$ NAAQS. As such the modeled attainment test must consider monitored baseline design values from each of these locations. EPA's modeling guidance[1] recommends this be calculated using three-year averages of the 98^{th} percentile values. To calculate the monitored baseline design value, EPA recommends an average of three such three-year averages that straddle the baseline inventory. 2008 is the year represented by the baseline inventory. Therefore, the three-year average of 98^{th} percentile values collected from 2006-2008 would be averaged together with the three-year averages for 2007-2009 and 2008-2010 to arrive at the site-specific monitored baseline design values. These values are also shown in Table 3.2.

3.5 Composition of Fine Particle Pollution – Speciated Monitoring Data

DAQ operates three $PM_{2.5}$ speciation sites. The Hawthorne site in Salt Lake County is one of 54 Speciation Trends Network (STN) sites operated nationwide on an every-third day sampling schedule. Sites at Bountiful/Viewmont in Davis County and Lindon in Utah County are State and Local Air Monitoring Stations (SLAMS) $PM_{2.5}$ speciation sites that operate on an every-sixth-day sampling schedule.

Samples are prepared by the EPA contract laboratory and shipped to Utah for sampling. Samples are collected for particulate mass, elemental analysis, identification of major cations and anions, and concentrations of elemental and organic carbon as well as crustal material present in $PM_{2.5}$. Carbon sampling and analysis changed in 2007 to match the Interagency Monitoring of Protected Visual Environments (IMPROVE) method using a modified IMPROVE sampler at all sites.

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[1] Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze (EPA -454B-07-002, April 2007)

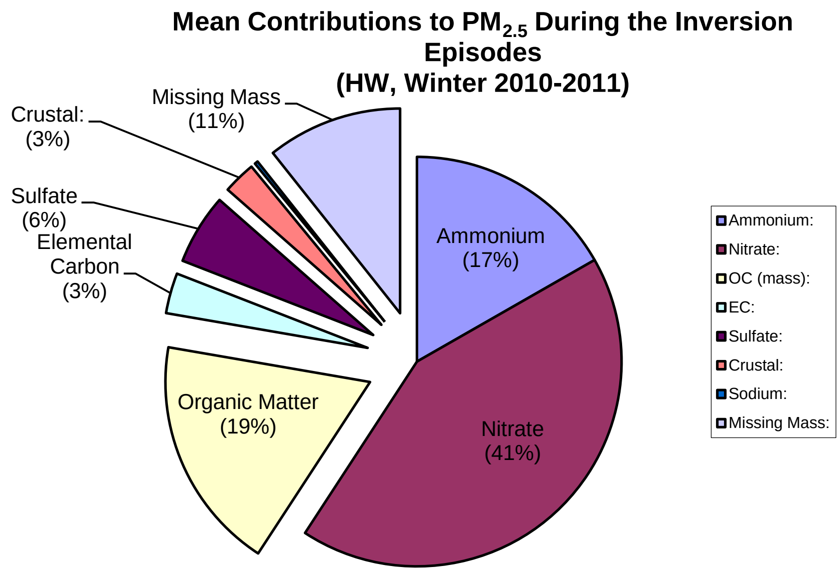
The $PM_{2.5}$ is collected on three types of filters: teflon, nylon, and quartz. Teflon filters are used to characterize the inorganic contents of $PM_{2.5}$. Nylon filters are used to quantify the amount of ammonium nitrate, and quartz filters are used to quantify the organic and inorganic carbon content in the ambient $PM_{2.5}$.

Data from the speciation network show the importance of volatile secondary particulates during the colder months. These particles are significantly lost in FRM $PM_{2.5}$ sampling.

During the winter periods between 2009 and 2011, DAQ conducted special winter speciation studies aimed at better characterization of $PM_{2.5}$ during the high pollution episodes. These studies were accomplished by shifting the sampling of the Chemical Speciation Network monitors to 1-in-2 schedule during the months of January and February. Speciation monitoring during the winter high-pollution episodes produced similar results in $PM_{2.5}$ composition each year.

The results of the speciation studies lead to the conclusion that the exceedances of the $PM_{2.5}$ NAAQS are a result of the increased portion of the secondary $PM_{2.5}$ that was chemically formed in the air and not emitted directly into the troposphere.

Figure 3.2 below shows the contribution of the identified compounds from the speciation sampler both during a winter atmospheric inversion period and during a clear winter period.



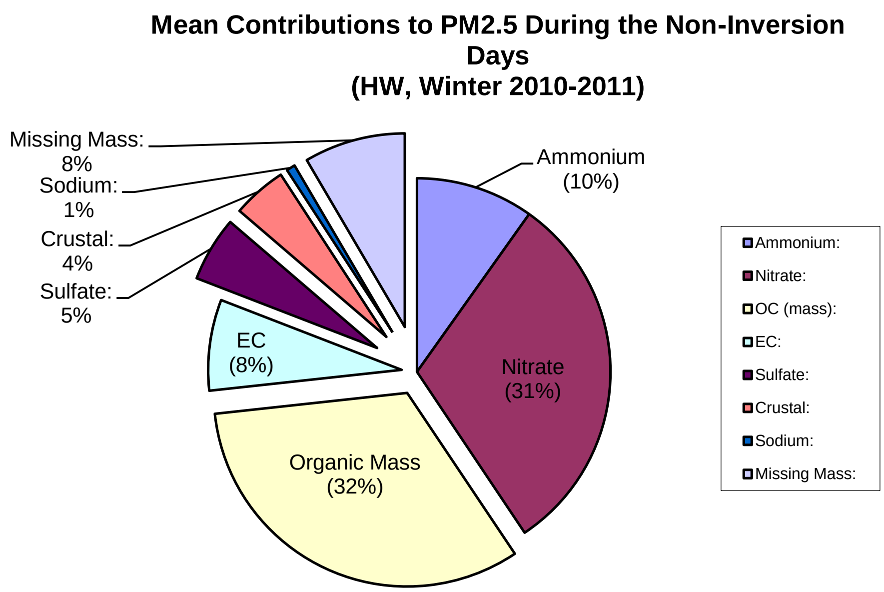


Figure 3.2, Composite Wintertime $PM_{2.5}$ Speciation Profiles

3.6 $PM_{2.5}$ Saturation Studies

Utah State University conducted a study of the homogeneity of PM_{10} in Cache Valley in 2002-2003 and a study of the homogeneity of $PM_{2.5}$ in 2003-2004. In addition to the permanent DAQ air quality monitoring site in Logan, seventeen sites measuring $PM_{2.5}$ concentrations were established in Cache Valley. Measurements of $PM_{2.5}$ concentrations were made every six days from November 2003 – February 2004. Several temperature inversions developed during the course of the study with $PM_{2.5}$ concentrations in Logan ranging from 3-128 $\mu g/m^3$. In general, the study found that $PM_{2.5}$ concentrations were homogenous throughout the entirety of Cache Valley. On days with $PM_{2.5}$ concentrations < 65 $\mu g/m^3$, mean $PM_{2.5}$ concentrations at 11 of the 17 sites had values within 20% of the mean $PM_{2.5}$ concentration for the entire valley. $PM_{2.5}$ concentrations were generally most homogenous throughout Cache Valley on days when $PM_{2.5}$ concentrations were > 65 $\mu g/m^3$. On high $PM_{2.5}$ days (>65 $\mu g/m^3$), mean $PM_{2.5}$ concentrations at only two sites were statistically different from the mean $PM_{2.5}$ concentration for all of Cache Valley. The study concluded that $PM_{2.5}$ concentrations in Cache Valley were homogenous, within a 95% confidence interval, during the winter of 2003-2004.[1] $PM_{2.5}$ saturation studies have not been conducted in other regions of Utah.

3.7 PCAP Study

The Persistent Cold Air Pooling Study (PCAPS) is an ongoing National Science Foundation-funded project conducted by the University of Utah to investigate the processes leading to the formation, maintenance and destruction of persistent temperature inversions in Salt Lake Valley. Field work for the project was conducted in the winter of 2010-2011 and focused on the meteorological dynamics of temperature inversions in the Salt Lake Valley and in the Bingham Canyon pit mine in the southwest corner of Salt Lake Valley. In addition to identifying key meteorological processes involved in the dynamics of temperature inversions in Salt Lake Valley, the other primary objectives of PCAPS is to determine how persistent temperature inversions affect air pollution transport and diffusion in urban basins and to develop more accurate meteorological models describing the formation, persistence and dispersion of temperature inversions in Salt Lake Valley.

Analyses of most data sets collected during the PCAPS are still underway. However, one study examining $PM_{2.5}$ concentrations along an elevation gradient north of Salt Lake City (1300-1750 meters) showed that $PM_{2.5}$ concentrations generally decreased with altitude and increased with time during a single temperature inversion event.[2] Final results from PCAPS will help DAQ understand both how persistent temperature inversions affect $PM_{2.5}$ concentrations along the Wasatch Front and will enhance DAQ's ability to accurately forecast the formation and breakup of temperature inversion that lead to poor wintertime air quality.

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[1] Martin, R., and G.W. Koford, 2006: Valley-wide PM_{10} and $PM_{2.5}$ Saturation (Homogeneity) Studies, found within: Cache Valley Air Quality Studies: A Summary of Research Conducted.

[2] Silcox, G.D., K.E. Kelly, E.T. Crosman, C.D. Whiteman, and B.L. Allen, 2012: Wintertime $PM_{2.5}$ concentrations in Utah's Salt Lake Valley during persistent multi-day cold air pools. Atmospheric Environment, **46**, 17-24.

3.8 Ammonia (NH_3) Studies

The Division of Air Quality deployed an ammonia monitor as a part of the special winter study for 2009. A URG 9000 instrument was used to record hourly values of ambient ammonia between the months of December and February.

The resulting measurements showed that the ambient concentration of ammonia tended to be generally an order of magnitude higher than those of nitric acid: 12-17 ppbv and 1-2 ppbv, respectively.

Unfortunately, the use of the instrument proved to be excessively labor intensive due to the high frequency of calibrations and corrections for drift. The data obtained during the winter of 2009, albeit valuable for rough estimation of the ambient ammonia concentrations, contained an abnormal amount of error for accurate mechanistic analysis.

Chapter 4 – EMISSION INVENTORY DATA

4.1 Introduction

The emissions inventory is one means used by the state to assess the level of pollutants and precursors released into the air from various sources. The methods by which emissions inventories are collected and calculated are constantly improving in response to better analysis and more comprehensive rules. The inventories underlying this SIP were compiled using the best information available.

The sources of emissions that were inventoried may be discussed as belonging to four general categories: industrial point sources, on-road mobile sources, off-road mobile sources., and area sources which represent a collection of smaller, more numerous point sources, residential activities such a home heating, and in some cases biogenic emissions.

This SIP is concerned with $PM_{2.5}$, both primary in its origin and secondary, referring to its formation removed in time and space from the point of origin for certain precursor gasses. Hence, the pollutants of concern, at least for inventory development purposes, included $PM_{2.5}$, SO_2, NO_x, VOC, and NH_3.

On-road mobile sources are inventoried using EPA's MOVES model, in conjunction with information generated by travel demand models such as vehicle speeds and miles traveled. The inventory information is calculated in units of tons per day, adjusted for winter conditions. Emissions from the other three categories are calculated in terms of tons per year.

Prior to use in the air quality model, the emissions are pre-processed to account for the seasonality of Utah's difficulty with secondary $PM_{2.5}$ formation during winter months. These temporal adjustments also account for daily and weekly activity patterns that affect the generation of these emissions.

To acknowledge the episodic and seasonal nature of Utah's elevated $PM_{2.5}$ concentrations, inventory information presented herein is, unless otherwise noted, a reflection of the temporal adjustments made prior to air quality modeling. This makes more appropriate the use of these inventories for such purposes as correlation with measured $PM_{2.5}$ concentrations, control strategy evaluation, establishing budgets for transportation conformity, and tracking rates of progress.

There are various time horizons that are significant to the development of this SIP. It is first necessary to look at past episodes of elevated $PM_{2.5}$ concentrations in order to develop the air quality model. The episodes studied as part of the SIP occurred in 2007, 2008, 2009, and 2010. It is then necessary to look several years into the future when developing emission control strategies. The significant time horizons relate to the statutory attainment dates associated with the 2006 $PM_{2.5}$ NAAQS. These dates may range from 2014 to 2019. Inventories must be prepared to evaluate all of these time horizons.

4.2 The 2008 Emissions Inventory

The forgoing paragraph identified numerous points in time for which an understanding of emissions to the air is important to plan development. The basis for each of these assessments was the 2008 tri-annual inventory. This inventory represented, at the time it was selected for use, the most recent comprehensive inventory compiled by UDAQ. In addition to the large major point sources that are required to report emissions every year, the tri-annual inventories consider emissions from many more, smaller point sources. These inventories are collected in accordance with state and federal rules that ensure proper methods and comprehensive quality assurance.

Thus, to develop other inventories for each of the years discussed above, the 2008 inventory was either back-cast and adjusted for certain episodic conditions, or forecast to represent more typical conditions.

4.3 Characterization of Utah's Airsheds

As said at the outset, an emissions inventory provides a means to assess the level of pollutants and precursors released into the air from various sources. This in turn allows for an overall assessment of a particular airshed or even a comparison of one airshed to another.

The modeling analysis used to support this SIP considers a regional domain that encompasses three distinct airsheds belonging to three distinct $PM_{2.5}$ nonattainment areas; The Cache Valley (the Logan UT/ID nonattainment area), the central Wasatch Front (Salt Lake City, UT nonattainment area), and the southern Wasatch Front (Provo, UT nonattainment area).

The inventories developed for each of these three areas illustrate many similarities but also a few notable differences. All three areas are more or less dominated by a combination of on-road mobile and area sources. However, emissions from large point sources are non-existent in the Cache Valley. These emissions are situated along the Wasatch Front, and primarily exhibited in the Salt Lake City nonattainment area. Conversely, most of the agricultural emissions are located in the Cache Valley.

The tables presented below provide a broad overview of the emissions in each of the three areas. They are organized to show the relative contributions of emissions by source category (e.g. point / area / mobile).

Table 4.1 shows the 2008 Baseline emissions in each area of the modeling domain.

	NA-Area	Source Category	PM2_5	NOX	VOC	NH3	SO2
2008	Logan, UT-ID						
Sum of Emissions (tpd)		Area Sources	0.46	1.95	6.13	11.61	0.34
		Mobile Sources	0.46	8.25	6.43	0.13	0.09
		NonRoad	0.07	0.73	1.29	0.00	0.07
		Point Sources	0.00	0.02	0.41	0.00	0.00
	Total		0.99	10.95	14.26	11.75	0.50
2008	Provo, UT						
Sum of Emissions (tpd)		Area Sources	1.46	6.49	12.57	6.49	0.37
		Mobile Sources	1.62	31.82	17.97	0.48	0.34
		NonRoad	0.04	0.69	0.67		0.11
		Point Sources	0.26	0.89	0.61	0.28	0.03
	Total		3.38	39.90	31.81	7.26	0.84
2008	Salt Lake City, UT						
Sum of Emissions (tpd)		Area Sources	4.58	23.75	50.59	17.92	1.43
		Mobile Sources	6.14	119.04	70.88	2.04	1.41
		NonRoad	0.53	9.30	11.20		0.69
		Point Sources	4.67	23.68	7.28	0.64	10.18
	Total		15.93	175.77	139.94	20.60	13.72
2008	Surrounding Areas						
Sum of Emissions (tpd)		Area Sources	9.57	38.30	51.18	185.35	10.89
		Mobile Sources	2.89	65.51	24.30	0.61	0.42
		NonRoad	1.58	14.23	33.67	0.00	0.27
		Point Sources	7.16	185.79	2.66	2.31	113.15
	Total		21.21	303.83	111.82	188.27	124.72
2008 Total			41.50	530.45	297.83	227.88	139.78

Table 4.1, Emissions Summary for 2008

Table 4.2 is specific to the Salt Lake, UT nonattainment area, and shows emissions for the attainment year as well as any other significant milestone year. These subsequent totals include projections concerning growth in population, vehicle miles traveled, and the economy. They also include the effects of emissions control strategies that are either already promulgated or were required as part of the SIP.

	NA-Area	Source Category	PM2_5	NOX	VOC	NH3	SO2
2008	Salt Lake City, UT						
Sum of Emissions (tpd)		Area Sources	4.58	23.75	50.59	17.92	1.43
		Mobile Sources	6.14	119.04	70.88	2.04	1.41
		NonRoad	0.53	9.30	11.20		0.69
		Point Sources	4.67	23.68	7.28	0.64	10.18
	Total		15.93	175.77	139.94	20.60	13.72
2014	Salt Lake City, UT						
Sum of Emissions (tpd)		Area Sources	3.79	22.49	41.31	18.25	0.62
		Mobile Sources	4.61	81.15	47.33	1.61	0.59
		NonRoad	0.92	13.64	12.61		0.72
		Point Sources	5.71	27.45	9.33	0.70	0.10
	Total		15.04	144.73	110.58	20.56	2.02
2017	Salt Lake City, UT						
Sum of Emissions (tpd)		Area Sources	3.82	20.25	42.31	18.57	0.63
		Mobile Sources	4.11	68.02	40.36	1.51	0.59
		NonRoad	0.80	12.37	11.98		0.39
		Point Sources	5.75	27.94	9.82	0.74	8.84
	Total		14.48	128.58	104.47	20.82	10.44
2019	Salt Lake City, UT						
Sum of Emissions (tpd)		Area Sources	3.49	15.83	43.62	18.68	0.61
		Mobile Sources	3.50	56.10	33.38	1.42	0.58
		NonRoad	0.71	10.90	12.82		0.73
		Point Sources	5.39	22.06	9.34	0.76	7.19
	Total		13.09	104.89	99.17	20.86	9.10

Table 4.2, Emissions Summaries for the Salt Lake City, UT-ID Nonattainment Area; Baseline and Attainment Year

More detailed inventory information may be found in the Technical Support Document (TSD).

Chapter 5 – ATTAINMENT DEMONSTRATION

5.1 Introduction

UDAQ conducted a technical analysis to support the development of Utah's 24-hr $PM_{2.5}$ State Implementation Plan (SIP). The analyses include preparation of emissions inventories and meteorological data, and the evaluation and application of regional photochemical model. An analysis using observational datasets will be shown to detail the chemical regimes of Utah's Nonattainment areas.

5.2 Photochemical Modeling

Photochemical models are relied upon by federal and state regulatory agencies to support their planning efforts. Used properly, models can assist policy makers in deciding which control programs are most effective in improving air quality, and meeting specific goals and objectives.

The air quality analyses were conducted with the Community Multiscale Air Quality CMAQ Model version 4.7.1, with emissions and meteorology inputs generated using SMOKE and WRF, respectively. CMAQ was selected because it is the open source atmospheric chemistry model co-sponsored by EPA and the National Oceanic Atmospheric Administration (NOAA), thus approved by EPA for this plan.

5.3 Domain/Grid Resolution

UDAQ selected a high resolution 4-km modeling domain to cover all of northern Utah including the portion of southern Idaho extending north of Franklin County and west to the Nevada border (Figure 5.1). This 97 x 79 horizontal grid cell domain was selected to ensure that all of the major emissions sources that have the potential to impact the nonattainment areas were included. The vertical resolution in the air quality model consists of 17 layers extending up to 15 km, with higher resolution in the boundary layer.

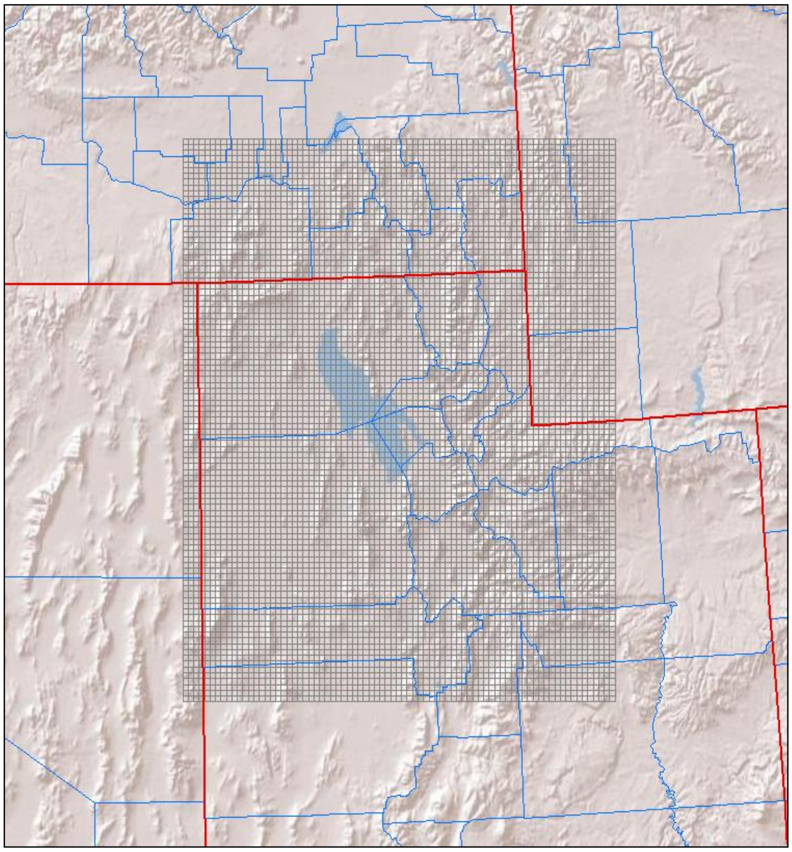

Figure 5.1: Northern Utah photochemical modeling domain.

5.4 Episode Selection

According to EPA's April 2007 "Guidance on the Use of Models and Other Analyses for Demonstrating Attainment of Air Quality Goals for Ozone, $PM_{2.5}$, and Regional Haze" the selection of SIP episodes for modeling should consider the following 4 criteria:

1. Select episodes that represent a variety of meteorological conditions that lead to elevated $PM_{2.5}$.
2. Select episodes during which observed concentrations are close to the baseline design value.
3. Select episodes that have extensive air quality data bases.
4. Select enough episodes such that the model attainment test is based on multiple days at each monitor violating NAAQS.

In general, UDAQ wanted to select episodes with hourly $PM_{2.5}$ concentrations that are reflective of conditions that lead to 24-hour NAAQS exceedences. From a synoptic meteorology point of view, each selected episode features a similar pattern. The typical pattern includes a deep trough over the eastern United States with a building and eastward moving ridge over the western United States. The episodes typically begin as the ridge begins to build eastward, near surface winds weaken, and rapid stabilization due to warm advection and subsidence dominate. As the ridge centers over Utah and subsidence peaks, the atmosphere becomes extremely stable and a subsidence inversion descends towards the surface. During this time, weak insolation, light winds, and cold temperatures promote the development of a persistent cold air pool. Not until the ridge moves eastward or breaks down from north to south is there enough mixing in the atmosphere to completely erode the persistent cold air pool.

From the most recent 5-year period of 2007-2011, UDAQ developed a long list of candidate $PM_{2.5}$ wintertime episodes. Three episodes were selected. An episode was selected from January 2007, an episode from February 2008, and an episode during the winter of 2009-2010 that features multi-event episodes of $PM_{2.5}$ buildup and washout. Further detail of the episodes is below:

- **Episode 1: January 11-20, 2007**

A cold front passed through Utah during the early portion of the episode and brought very cold temperatures and several inches of fresh snow to the Wasatch Front. The trough was quickly followed by a ridge that built north into British Columbia and began expanding east into Utah. This ridge did not fully center itself over Utah, but the associated light winds, cold temperatures, fresh snow, and subsidence inversion produced very stagnant conditions along the Wasatch Front. High temperatures in Salt Lake City throughout the episode were in the high teens to mid-20's Fahrenheit.

Figure 5.2 shows hourly $PM_{2.5}$ concentrations from Utah's 4 $PM_{2.5}$ monitors for January 11-20, 2007. The first 6 to 8 days of this episode are suited for modeling. The episode becomes less suited after January 18 because of the complexities in the meteorological conditions leading to temporary $PM_{2.5}$ reductions.

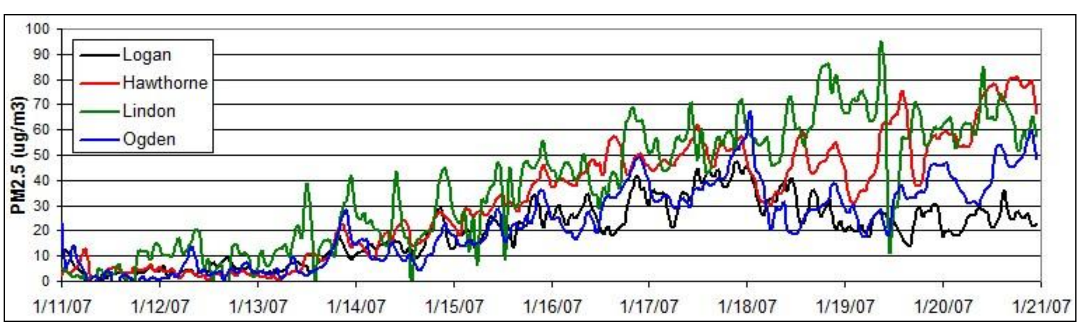

Figure 5.2: Hourly $PM_{2.5}$ concentrations for January 11-20, 2007

- **Episode 2: February 14-18, 2008**

The February 2008 episode features a cold front passage at the start of the episode that brought significant new snow to the Wasatch Front. A ridge began building eastward from the Pacific Coast and centered itself over Utah on Feb 20th. During this time a subsidence inversion lowered significantly from February 16 to February 19. Temperatures during this episode were mild with high temperatures at KSLC in the upper 30's and lower 40's Fahrenheit.

The 24-hour average $PM_{2.5}$ exceedances observed during the proposed modeling period of February 14-19, 2008 were not exceptionally high. What makes this episode a good candidate for modeling are the high hourly values and smooth concentration build-up. The first 24-hour exceedances occurred on February 16 and was followed by a rapid increase in $PM_{2.5}$ through the first half of February 17 (Figure 5.3). During the second half of February 17, a subtle meteorological feature produced a mid-morning partial mix-out of particulate matter and forced 24-hour averages to fall. After February 18, the atmosphere began to stabilize again and resulted in even higher $PM_{2.5}$ concentrations during February 20, 21, and 22. Modeling the 14th through the 19th of this episode should successfully capture these dynamics. The smooth gradual build-up of hourly $PM_{2.5}$ is ideal for modeling.

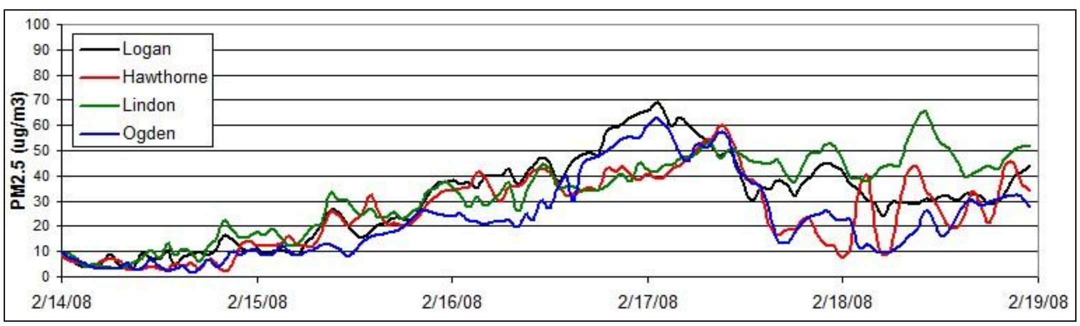

Figure 5.3: Hourly $PM_{2.5}$ concentrations for February 14-19, 2008

- **Episode 3: December 13, 2009 – January 18, 2010**

The fourth episode that was selected is more similar to a "season" than a single $PM_{2.5}$ episode (Figure 5.4). During the winter of 2009 and 2010, Utah was dominated by a semi-permanent ridge of high pressure that prevented strong storms from crossing Utah. This 35 day period was characterized by 4 to 5 individual $PM_{2.5}$ episodes each followed by a partial $PM_{2.5}$ mix out when a weak weather system passed through the ridge. The long length of the episode and repetitive $PM_{2.5}$ build-up and mix-out cycles makes it ideal for evaluating model strengths and weaknesses and $PM_{2.5}$ control strategies.

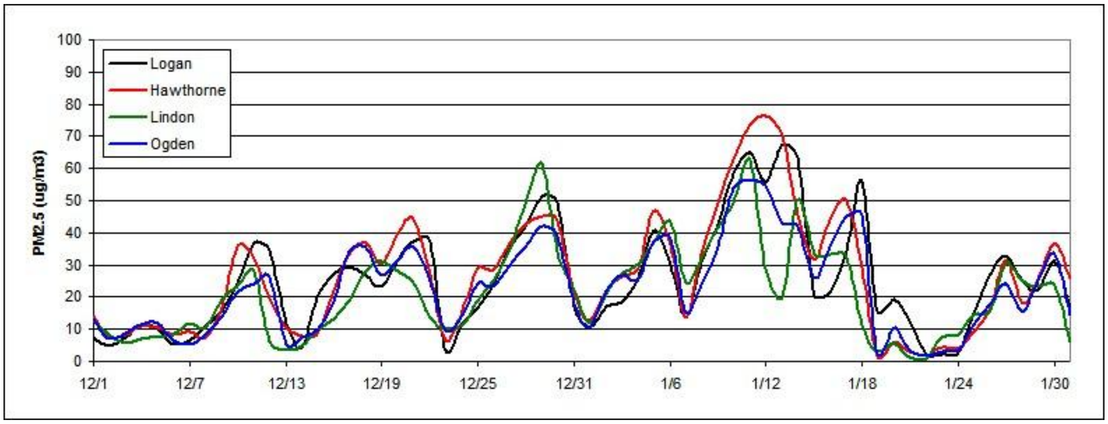

Figure 5.4: 24-hour average $PM_{2.5}$ concentrations for December-January, 2009-10.

5.5 Meteorological Data

Meteorological inputs were derived using the Weather Research and Forecasting (WRF), Advanced Research WRF (WRF-ARW) model version 3.2. WRF contains separate modules to compute different physical processes such as surface energy budgets and soil interactions, turbulence, cloud microphysics, and atmospheric radiation. Within WRF the user has many options for selecting the different schemes for each type of physical process. There is also a WRF Preprocessing System (WPS) that generates the initial and boundary conditions used by WRF, based on topographic datasets, land use information, and larger-scale atmospheric and oceanic models.

Model performance of WRF was assessed against observations at sites maintained by the Utah Air Monitoring Center. A summary of the performance evaluation results for WRF are presented below:

- The biggest issue with meteorological performance is the existence of a warm bias in surface temperatures during high $PM_{2.5}$ episodes. This warm bias is a common trait of WRF modeling during Utah wintertime inversions.
- WRF does a good job of replicating the light wind speeds (< 5 mph) that occur during high $PM_{2.5}$ episodes.
- WRF is able to simulate the diurnal wind flows common during high $PM_{2.5}$ episodes. WRF captures the overnight downslope and daytime upslope wind flow that occurs in Utah valley basins.
- WRF has reasonable ability to replicate the vertical temperature structure of the boundary layer (i.e., the temperature inversion). Although it is difficult for WRF to reproduce the inversion when the inversion is shallow and strong (i.e., an 8 degree temperature increase over 100 vertical meters).

5.6 Photochemical Model Performance Evaluation

The model performance evaluation focused on the magnitude, spatial pattern, and temporal variation of modeled and measured concentrations. This exercise was intended to assess whether, and to what degree, confidence in the model is warranted (and to assess whether model improvements are necessary).

CMAQ model performance was assessed with observed air quality datasets at UDAQ-maintained air monitoring sites (Figure 5.5). Measurements of observed $PM_{2.5}$ concentrations along with gaseous precursors of secondary particulate (e.g., NO_x, ozone) and carbon monoxide are made throughout winter at most of the locations in Figure 5.5. $PM_{2.5}$ speciation performance was assessed using the three Speciation Monitoring Network Sites (STN) located at the Hawthorne site in Salt Lake City, the Bountiful site in Davis County, and the Lindon site in Utah County.

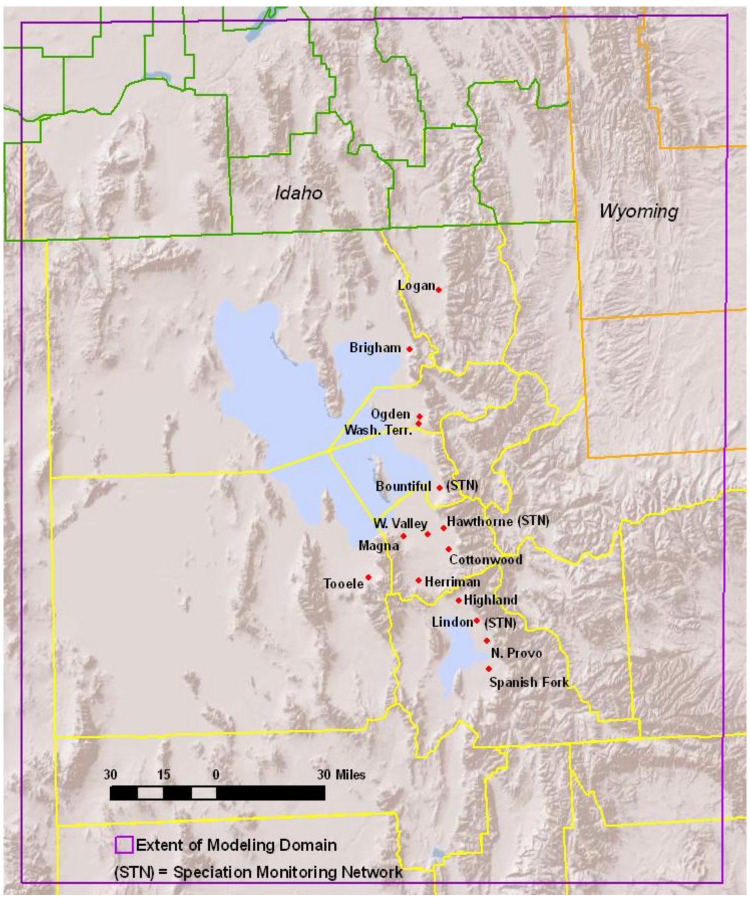

Figure 5.5: UDAQ monitoring network.

A spatial plot is provided for modeled 24-hr $PM_{2.5}$ for 2010 January 03 in Figure 5.6. The spatial plot shows the model does a reasonable job reproducing the high $PM_{2.5}$ values, and keeping those high values confined in the valley locations where emissions occur.

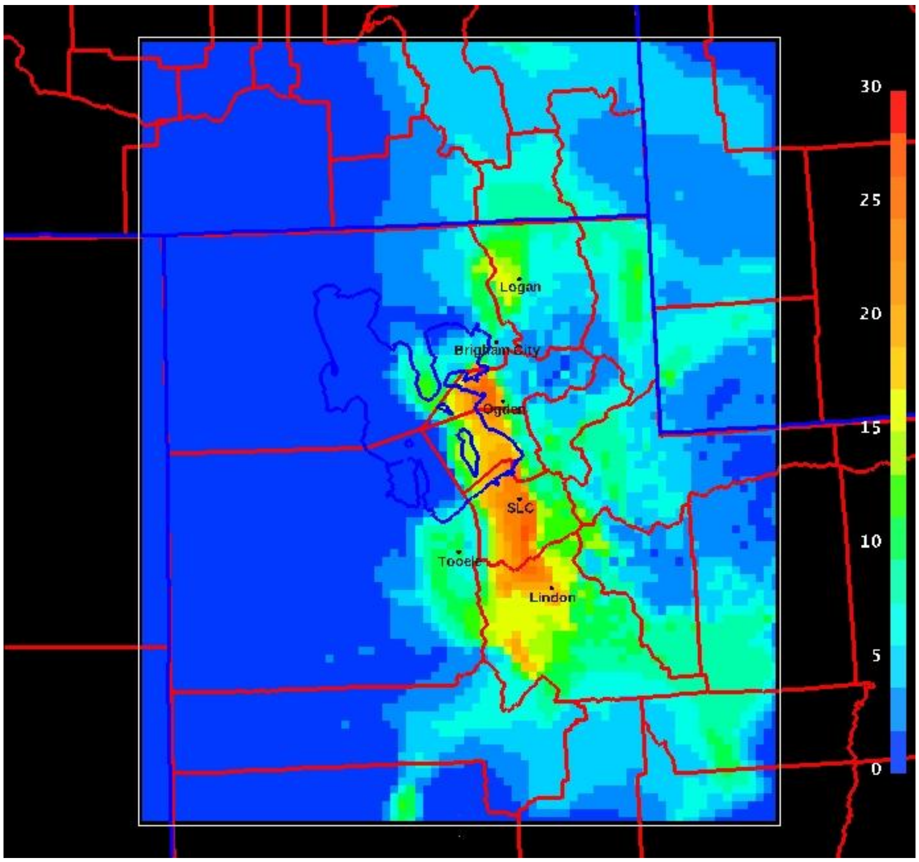

Figure 5.6: Spatial plot of CMAQ modeled 24-hr $PM_{2.5}$ ($\mu g/m^3$) for 2010 Jan. 03.

Time series of 24-hr $PM_{2.5}$ concentrations for the 13 Dec. 2009 – 015 Jan. 2010 modeling period are shown in Figs. 5.7 – 5.10 at the Hawthorne site in Salt Lake City (Fig. 5.7), the Ogden site in Weber County (Fig 5.8), the Lindon site in Utah County (Fig. 5.9), and the Logan site in Cache County (Fig. 5.10). For the most part, CMAQ replicates the buildup and washout of each individual episode. While CMAQ builds 24-hr $PM_{2.5}$ concentrations during the 08 Jan. – 014 Jan. 2010 episode, it was not able to produce the > 60 $\mu g/m^3$ concentrations observed at the monitoring locations.

It is often seen that CMAQ "washes" out the $PM_{2.5}$ episode a day or two earlier than that seen in the observations. For example, on the day 21 Dec. 2009, the concentration of $PM_{2.5}$ continues to build while CMAQ has already cleaned the valley basins of high $PM_{2.5}$ concentrations. At these times, the observed cold pool that holds the $PM_{2.5}$ is often very shallow and winds just above this cold pool are southerly and strong before the approaching cold front. This situation is very difficult for a meteorological and photochemical model to reproduce. An example of this situation is shown in Fig. 5.11, where the lowest part of the Salt Lake Valley is still under a very shallow stable cold pool, yet higher elevations of the valley have already been cleared of the high $PM_{2.5}$ concentrations.

During the 24 – 30 Dec. 2009 episode, a weak meteorological disturbance brushes through the northernmost portion of Utah. It is noticeable in the observations at the Ogden monitor at 25 Dec. as $PM_{2.5}$ concentrations drop on this day before resuming an increase through Dec. 30. The meteorological model and thus CMAQ correctly pick up this disturbance, but completely clears out the building $PM_{2.5}$; and thus performance suffers at the most northern Utah monitors of Ogden and Logan. The monitors to the south (Hawthorne, Lindon) are not influence by this disturbance and building of $PM_{2.5}$ is replicated by CMAQ. This highlights another challenge of modeling $PM_{2.5}$ episodes in Utah. Often during cold pool events, weak disturbances will pass through Utah that will de-stabilize the valley inversion and cause a partial clear out of $PM_{2.5}$. However, the $PM_{2.5}$ is not completely cleared out, and after the disturbance exits, the valley inversion strengthens and the $PM_{2.5}$ concentrations continue to build. Typically, CMAQ completely mixes out the valley inversion during these weak disturbances.

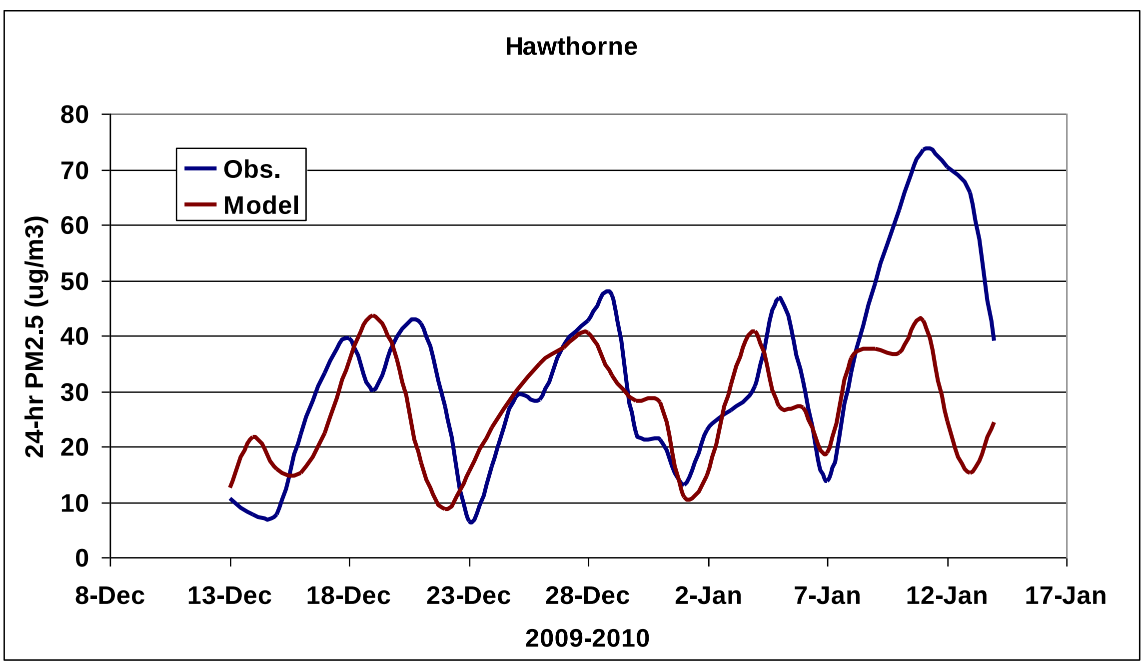

Figure 5.7: 24-hr $PM_{2.5}$ time series (Hawthorne). 24-hr PM2.5 time series. Observed 24-hr PM2.5 (blue trace) and CMAQ modeled 24-hr PM2.5 (red trace).

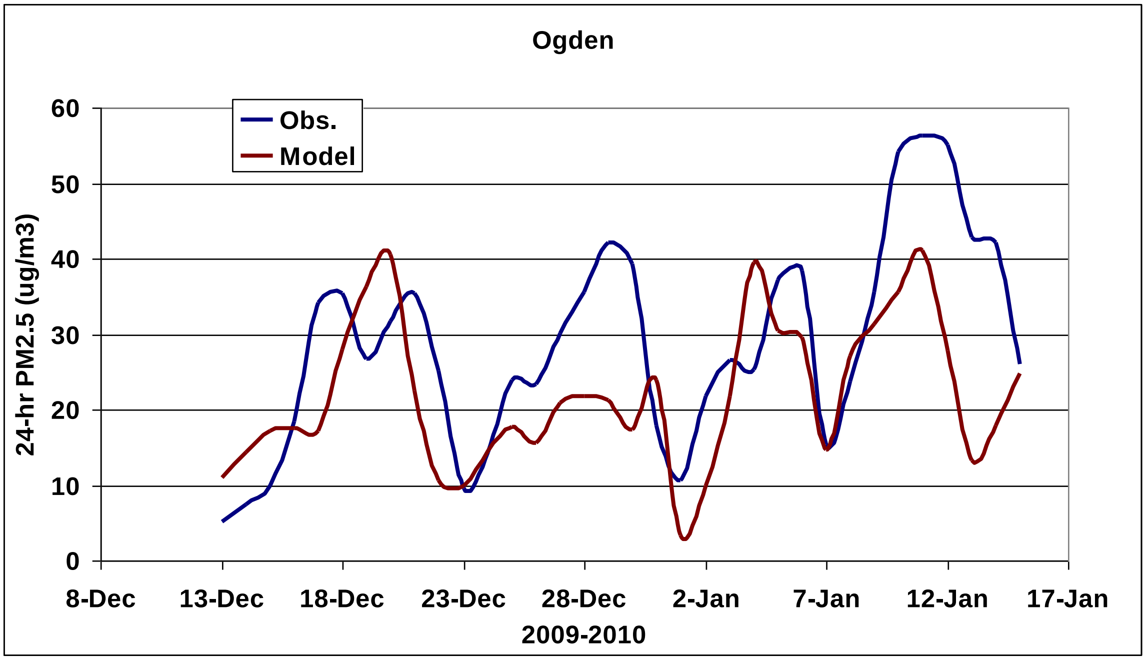

Figure 5.8: 24-hr PM$_{2.5}$ time series (Ogden). 24-hr PM2.5 time series. Observed 24-hr PM2.5 (blue trace) and CMAQ modeled 24-hr PM2.5 (red trace).

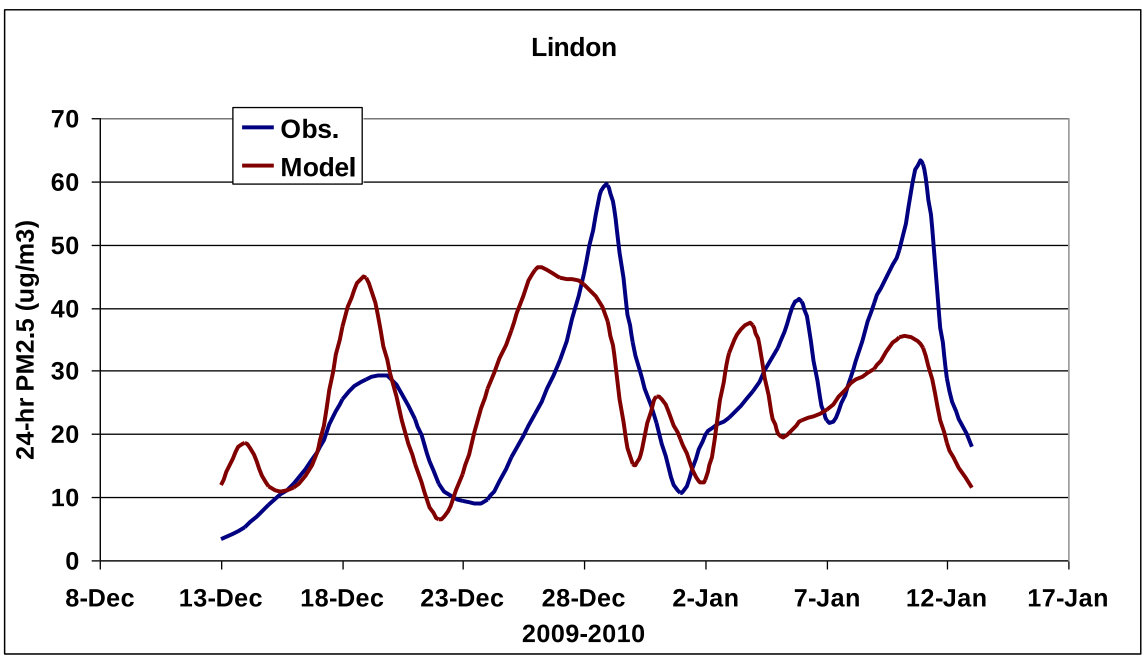

Figure 5.9: 24-hr PM$_{2.5}$ time series (Lindon). 24-hr PM2.5 time series. Observed 24-hr PM2.5 (blue trace) and CMAQ modeled 24-hr PM2.5 (red trace).

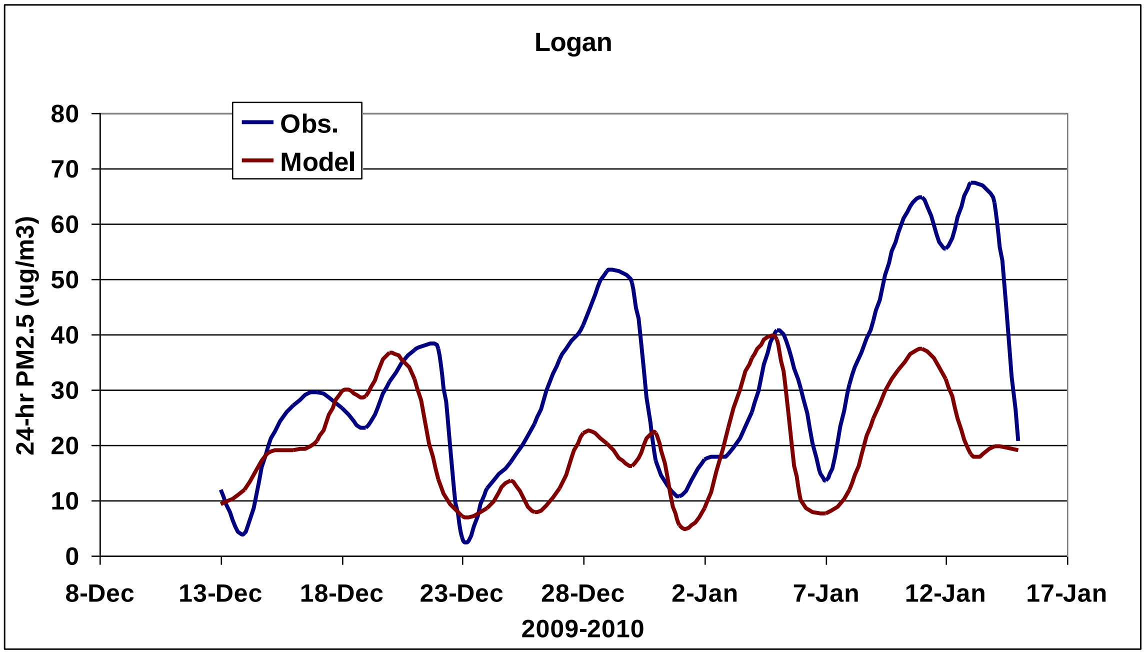

Figure 5.10: 24-hr $PM_{2.5}$ time series (Logan). 24-hr PM2.5 time series. Observed 24-hr PM2.5 (blue trace) and CMAQ modeled 24-hr PM2.5 (red trace).

Figure 5.11: An example of the Salt Lake Valley at the end of a high $PM_{2.5}$ episode. The lowest elevations of the Salt Lake Valley are still experiencing an inversion and elevated $PM_{2.5}$ concentrations while the $PM_{2.5}$ has been

'cleared out' throughout the rest of the valley. These 'end of episode' clear out periods are difficult to replicate in the photochemical model.

Generally, the performance of CMAQ to replicate the buildup and clear out of $PM_{2.5}$ is good. However, it is important to verify that CMAQ is replicating the components of $PM_{2.5}$ concentrations. $PM_{2.5}$ simulated and observed speciation is shown at the 3 STN sites in Figures 5.12 – 5.15. The observed speciation is constructed using days in which the STN filter 24-hr $PM_{2.5}$ concentration was > 25 μg/m^3. For the 2009-2010 modeling period, the observed speciation pie charts were created using 10 filter days at Hawthorne, 9 days at Lindon, and 8 days at Bountiful. The speciation of this small dataset appears similar to a comparison of a larger dataset of STN filter speciated data from 2005-2010 for high wintertime $PM_{2.5}$ days (see Figure 3.2 for one of these at Hawthorne).

The simulated speciation is constructed using modeling days that produced 24-hr $PM_{2.5}$ concentrations > 25 μg/m^3. Using this criterion, the simulated speciation pie chart is created from 18 modeling days for Hawthorne, 16 days at Lindon, and 16 days at Bountiful. At all 3 STN sites, the percentage of simulated nitrate is over-predicted by 5 to 7%. The simulated ammonium percentage is nearly identical to the observed STN speciation. At the Hawthorne site, organic carbon looks to be under-predicted by CMAQ with a percentage of $PM_{2.5}$ at 12% and an observed organic carbon at 21%. This discrepancy in organic carbon is not apparent at the Bountiful and Lindon site.

There is no STN site in the Logan nonattainment area, and very little speciation information is available in the Cache Valley. Figure 5.15 shows the simulated speciation at Logan. Ammonium (20%) and nitrate (60%) make up a higher percentage of the simulated $PM_{2.5}$ at Logan when compared to sites along the Wasatch Front.

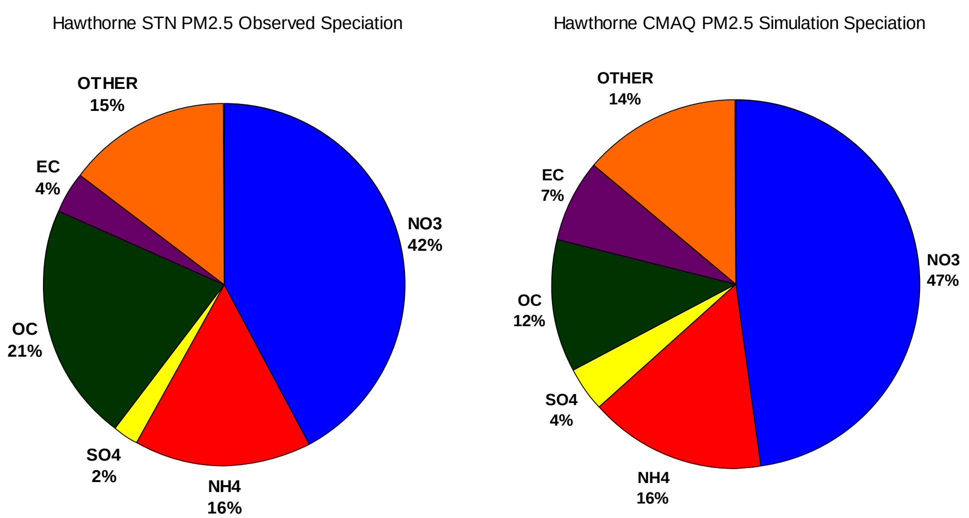

Figure 5.12: The composition of observed and model simulated average 24-hr $PM_{2.5}$ concentrations averaged over days when an observed and modeled day had 24-hr concentrations > 25 μg/m^3 at the Hawthorne STN site.

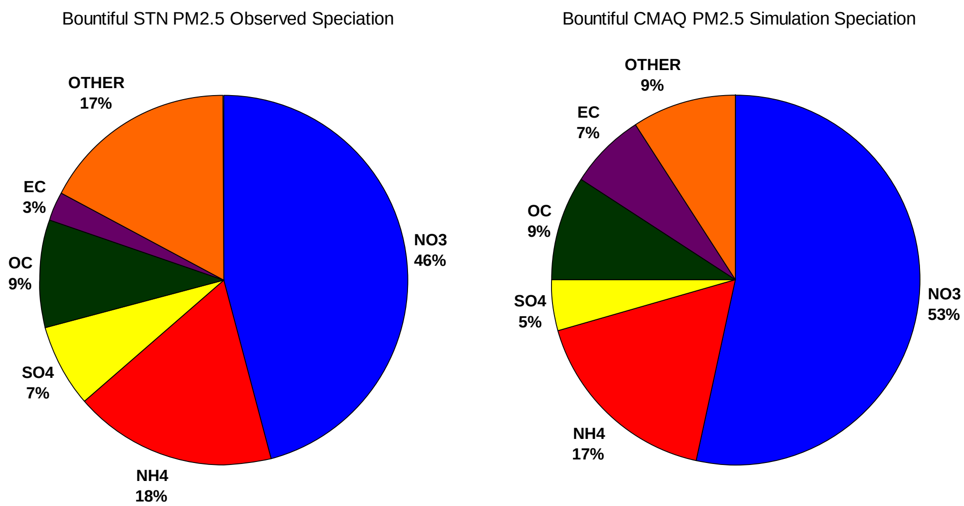

Figure 5.13: The composition of observed and model simulated average 24-hr $PM_{2.5}$ concentrations averaged over days when an observed and modeled day had 24-hr concentrations > 25 µg/m^3 at the Bountiful STN site.

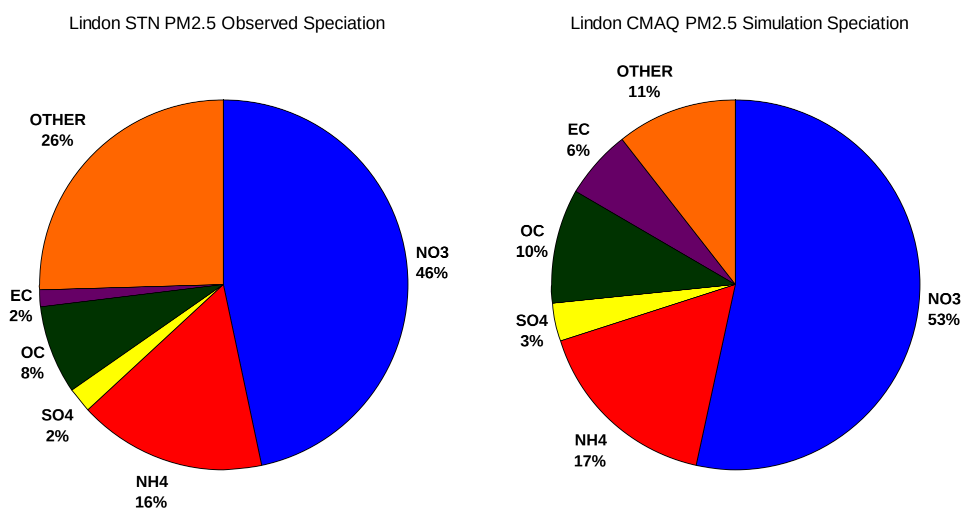

Figure 5.14: The composition of observed and model simulated average 24-hr $PM_{2.5}$ concentrations averaged over days when an observed and modeled day had 24-hr concentrations > 25 µg/m^3 at the Lindon STN site.

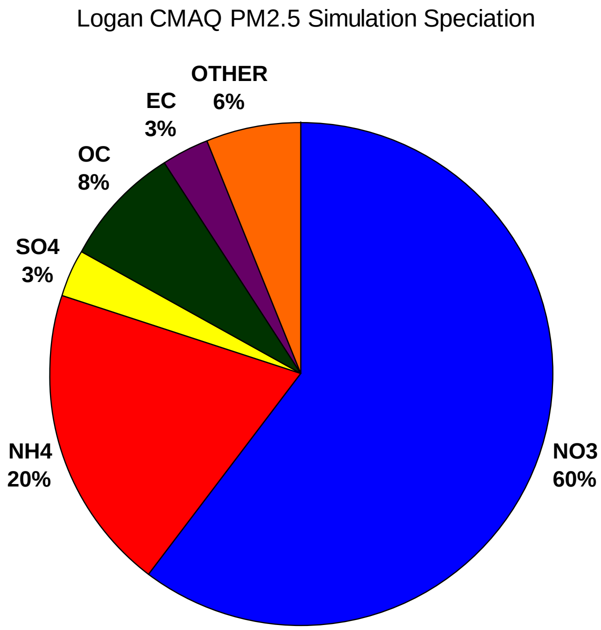

Figure 5.15: The composition of model simulated average 24-hr $PM_{2.5}$ concentrations averaged over days when a modeled day had 24-hr concentrations > 25 µg/m^3 at the Logan monitoring.

5.7 Summary of Model Performance

Model performance for 24-hr $PM_{2.5}$ is good and generally acceptable and can be characterized as follows:

- Good replication of the episodic buildup and clear out of $PM_{2.5}$. Often the model will clear out the simulated $PM_{2.5}$ a day too early at the end of an episode. This clear out time period is difficult to model (i.e., Figure 1.11).
- Good agreement in the magnitude of $PM_{2.5}$, as the model can consistently produce the high concentrations of $PM_{2.5}$ that coincide with observed high concentrations.
- Spatial patterns of modeled 24-hr $PM_{2.5}$, show for the most part, that the $PM_{2.5}$ is being confined in the valley basins, consistent to what is observed.
- Speciation and composition of the modeled $PM_{2.5}$ matches the observed speciation quite well. Modeled and observed nitrate are between 40% and 50% of the $PM_{2.5}$. Ammonium is between 15% and 20% for both modeled and observed $PM_{2.5}$. Organic carbon is underestimated at the Hawthorne location, but is reasonably estimated at the other locations (Bountiful, Lindon).

Several observations should be noted on the implications of these model performance findings on the attainment modeling presented in the following section. First, it has been demonstrated that model performance overall is acceptable and, thus, the model can be used for air quality planning purposes. Second, consistent with EPA guidance, the model is used in a relative sense to project future year values. EPA suggests that this approach “should reduce some of the uncertainty attendant with using absolute model predictions alone”. Furthermore, the attainment modeling is supplemented by additional information to provide a weight of evidence determination.

5.8 Modeled Attainment Test

UDAQ will use Model Attainment Test Software (MATS) for the modeled attainment test at grid cells near monitors. MATS is designed to interpolate the species fractions of the PM mass from the Speciation Trends Network (STN) monitors to the FRM monitors. The model also calculates the relative response factor (RRF) for grid cells near each monitor and uses these to calculate a future year design value for these cells.

UDAQ’s SIP protocol states MATS will also be used for conducting an unmonitored area analysis for daily average $PM_{2.5}$. However, the current release of MATS (v2.3.1) is unable to perform such an analysis. Therefore, UDAQ will not be including any further discussion of an unmonitored area analysis in this document.

MATS results for future year modeling is presented in Figure 5.16. The future year design values are presented for 2014, and 2019 the attainment year, along with the MATS future year design values for modeling simulation that include control strategies in each of those years. For comparison purposes, the monitored design value is also presented for the base year, 2008.

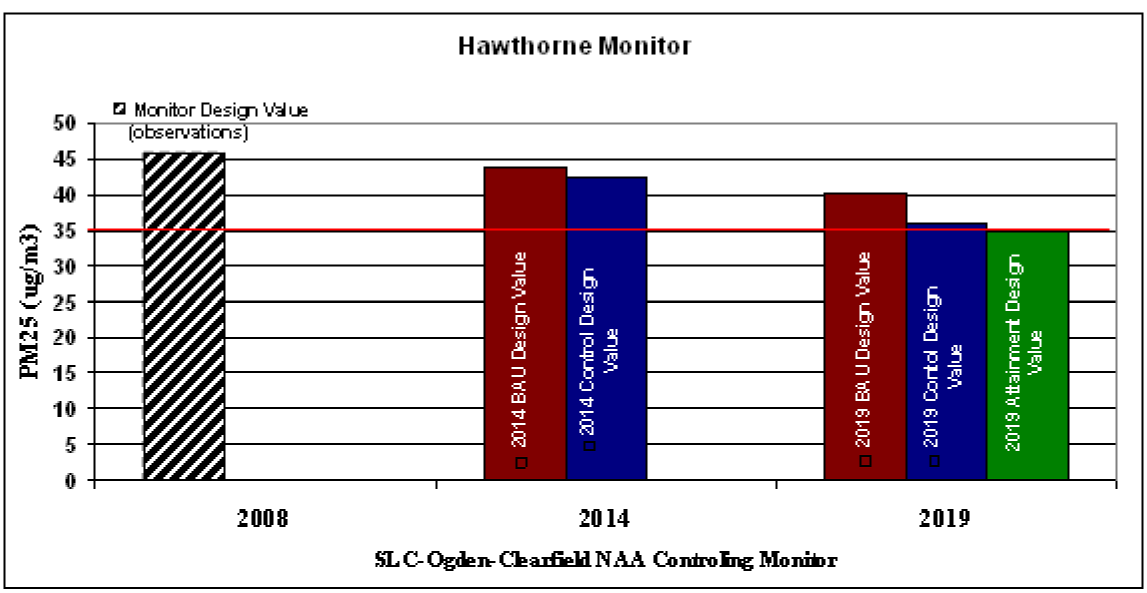

Figure 5.16, Model Results for the Salt Lake City, UT Nonattainment Area

Table 5.3 presents the same information in tabular form, and also includes any additional monitoring locations in the nonattainment area.

	2008	2014		2019		
	Observed	Business-As-Usual	Control Basket	Business-As-Usual	Control Basket	Attainment Inventory
Brigham City	31.1	28.3	26.7	27	24.3	-
Bountiful	36.9	34	33.3	30.8	28.5	-
Magma	30.8	29.3	29	28.4	24.7	-
Hawthorne	45.9	43.9	42.6	40.5	35.9	34.8
Rose Park	39.1	37.6	36.8	36.4	31.5	-
Ogden	38.1	35.9	34.3	36.7	32	-
Harrisville	35.8	33.7	31.8	32.2	28.4	-
Tooele City	22	20.7	20.6	20	19.1	-

Table 5.3, Modeled Concentrations for the Salt Lake City, UT Nonattainment Area

5.9 Attainment Date

As shown in the modeled attainment test, the emissions reductions achievable in 2014 do not allow for a demonstration that the Salt Lake City, UT nonattainment area can attain the 24-hour $PM_{2.5}$ NAAQS. Rather, additional reductions will be necessary in the time period between 2014 and 2019 in order to attain. Therefore, this plan identifies an attainment date of January 1, 2020, and requests that the Administrator extend the attainment date the full 5 years permissible under Section 172(a)(2) of the Act. A date of January 1, 2020 would reasonably allow for the consideration of monitoring data and inventory data collected during calendar year 2019 in making an assessment of whether the area has attained the standard, or would qualify for a one-year extension as outlined in Section 172(a)(2)(C) of the Clean Air Act.

Chapter 6 – CONTROL MEASURES

6.1 Introduction

Attaining the 24-hour NAAQS for $PM_{2.5}$ will require emission controls from directly emitted $PM_{2.5}$ as well as $PM_{2.5}$ plan precursors (SO_2, NO_x and VOC). It will involve emission sources from each of the four sectors identified in the discussion on emission inventories (stationary point sources, area sources, on-road mobile sources and off-road mobile sources). Furthermore, it will entail control measures of three basic types: existing measures, measures imposed through this SIP, and additional measures requiring additional development before they are ready for implementation.

This chapter summarizes the overall control strategy for the plan. Additional detail concerning individual emission control measures, including the emissions reductions to be expected, is contained in the Technical Support Document.

6.2 Utah Stakeholder Workgroup Efforts

In response to increasing interest in Utah's air quality problems and the need for greater participation in reducing air emissions, the Utah Division of Air Quality (DAQ) created a significant and meaningful role for public participation in the $PM_{2.5}$ SIP development process. The public involvement process was driven by a need for transparency and inclusivity of public health and business interests impacted by air quality issues.

DAQ's measures of success for the public involvement process were:

- Buy-in from public, stakeholders, and elected officials,
- SIP recommendations that are championed and implemented, and ;
- Close working relationship with partner organizations to deliver a unified message.

Measures of success for participants were:

- Having a say in plans that impacted their communities,
- Access to information and time to understand issues and provide input,
- Access to DAQ staff and the SIP development process,
- Meaningful participation in the process, and;
- Transparency in the process.

Public participation centered on creating workgroups with members from each county within the $PM_{2.5}$ nonattainment area—Box Elder, Cache, Davis, Salt Lake, Tooele, Utah, and Weber. More than 100 people from agriculture, academia, environmental groups, state and local elected officials, industry, and the public volunteered to participate. Their participation ensured that the SIP development process would have grassroots-level input about strategies and their impacts on a countywide level.

Workgroup members were engaged in four rounds of meetings created to provide and gather information. After providing a baseline level of knowledge during Meeting One, draft emissions reductions were discussed during Meetings Two and Three, each followed by a survey to capture new ideas and feedback. Responses from the survey, and other feedback received during the process, were used to refine emissions inventories, in some cases significantly, refine mitigation strategies, provide new strategies, and provide ideas for implementation. Meeting Four was an opportunity for workgroup members to introduce the SIP package to the public and talk about the development process before one of several public comment hearings held in the nonattainment counties.

The public participation process was not without challenges. One of the most difficult was providing information that could get a diverse group of stakeholders to understand very complex and technical air quality and emissions reductions issues. Despite the challenges, the process was successful and contributed to a well-rounded and well-vetted SIP package.

6.3 Identification of Measures

In considering the suite of control measures that could be implemented as part of this plan several important principles were applied to expedite the analysis.

Filter data shows that secondary particulate is the portion of mass most responsible for exceedances of the standard on episode days, and specifically shows that ammonium nitrate is the single largest component of that material. In addition, it shows that organic carbon represents the bulk of primary $PM_{2.5}$.

Priority was given to those source categories or pollutants responsible for relatively larger percentages of the emissions leading to exceedances of the $PM_{2.5}$ NAAQS. The emissions inventory compiled to represent base-year conditions was useful in identifying the contributors to these emissions, particularly in their relation to the formation of ammonium nitrate.

At the same time, the air quality modeling shed light on the sensitivity of the airshed in its response to changes in different pollutants. VOC was immediately identified as a significant contributor to elevated $PM_{2.5}$ concentrations, and proved to be more limiting in the overall atmospheric chemistry than NO_x. This pointed the search for viable control strategies toward VOC emissions, and somewhat away from NO_x. It also became apparent that directly emitted $PM_{2.5}$, while a relatively small portion of the overall filter mass, is independent of the non-linear chemical transformation to particulate matter. Therefore, any reduction in $PM_{2.5}$ emissions will directly improve future $PM_{2.5}$ concentrations, and like VOC, made these emissions an attractive target for potential control measures.

6.4 Existing Control Measures

The idea of controlling emissions to the airshed is not a new one. Since about 1970 there have been regulations at both the state and federal level to mitigate air contaminants. It follows that the estimates of emissions used in modeled attainment demonstration for this Plan take into account the effectiveness of existing control measures. These measures affect not only the levels of current emissions, but some continue to affect emissions trends as well.

An example of the former would be the effectiveness of an add-on control device at a stationary point source. It is presently effective in controlling emissions, and will continue to be that effective five years from now.

An example of the latter would be a federal rule that affects the manufacture of engines. The engines already sold into the airshed are effective in reducing emissions, but the number of these engines replacing older, higher emitting engines is increasing. Therefore, a rule such as this also affects the trend of emissions for that source category in a positive way.

The effectiveness of any control measure that was in place, and enforceable, at the time this Plan was written has been accounted for in the tabulation of baseline emissions and projected emissions. Other controls that are anticipated but not yet in place do not factor into the attainment demonstration underlying this Plan.

The following paragraphs discuss some of the more important control strategies that are already in place for the four basic sectors of the emissions inventory.

Stationary Point Sources:

Utah's permitting rules require a review of new and modified major stationary sources in nonattainment areas, as is required by Section 173 of the Clean Air Act. Beyond that however, even minor sources and minor modifications to major sources, planning to locate anywhere in the state, are required to undergo a new source review analysis and receive an approval order to construct. Part of this review is an analysis to ensure the application of Best Available Control Technology (BACT). This requirement is ongoing and ensures that Utah's industry is well controlled.

Along the central Wasatch Front, stationary sources were required to reduce emissions at several junctures to address nonattainment issues with SO_2, ozone and PM_{10}.

SIPs for ozone and SO_2 in 1981 affected all of the precursors to secondary particulate. There were SO_2 reductions at the copper smelter and VOC reductions at the refineries. In addition, Control Techniques

Guideline documents (CTGs) affecting VOC emissions at a variety of industrial source categories were incorporated into Utah's air quality rules.

In the early 1990s, stationary sources were required to reduce PM_{10}, SO_2, and NO_x to address wintertime PM_{10} nonattainment.

Any of the source-specific emission controls or operating practices that has been required as a result of the forgoing has been reflected in the baseline emissions calculated for the large stationary sources, and therefore evaluated in the modeled attainment demonstration.

<u>Area sources:</u>

Stage 1 vapor control was introduced in Salt Lake and Davis Counties as part of the 1981 ozone SIP. Since that time it has been extended to include the entire state.

Part of the PM_{10} control for Salt Lake and Davis Counties in the early 1990s was a program to curtail woodsmoke emissions during periods of atmospheric stagnation. Woodsmoke is rich in VOC emissions in addition to the particulate matter which is almost entirely within the $PM_{2.5}$ size fraction. In 2006 the woodburning program was extended to include the western half of Weber County as well.

CTGs adopted into Utah's air quality rules to control VOC emissions in Salt Lake and Davis Counties, as part of the 1981 ozone SIP, are also effective in controlling emissions from area sources.

On-road mobile sources:

The federal motor vehicle control program has been one of the most significant control strategies affecting emissions that lead to $PM_{2.5}$. Since 1968 , the program has required newer vehicles to meet ever more stringent emission standards for CO, NO_x, and VOC. Tier 1 standards were established in the early 1990s and were fully implemented by 1997. The Tier 1 emission standards can be found in Table 6.1. The EPA created a voluntary clean car program on January 7, 1998 (63 FR January 7, 1998), which was called the National Low Emission Vehicle (NLEV) program. This program asked auto manufacturers to commit to meet tailpipe standards for light duty vehicles that were more stringent than Tier 1 standards.

EPA Tier 1 Emission Standards for Passenger Cars and Light-Duty Trucks, FTP 75, g/mi

	100,000 miles/10 years[1]					
Category	**THC**	**NMHC**	**CO**	**NO_x[2] diesel**	***NO_x gasoline***	**PM[3]**
Passenger cars	-	0.31	4.2	1.25	*0.6*	0.1
LLDT, LVW <3,750 lbs	0.8	0.31	4.2	1.25	*0.6*	0.1
LLDT, LVW >3,750 lbs	0.8	0.4	5.5	0.97	*0.97*	0.1
HLDT, ALVW <5,750 lbs	0.8	0.46	6.4	0.98	*0.98*	0.1
HLDT, ALVW > 5,750 lbs	0.8	0.56	7.3	1.53	*1.53*	0.12

1 - Useful life 120,000 miles/11 years for all HLDT standards and for THC standards for LDT

2 - More relaxed NO_x limits for diesels applicable to vehicles through 2003 model year

3 - PM standards applicable to diesel vehicles only

Abbreviations:

LVW - loaded vehicle weight (curb weight + 300 lbs)

ALVW - adjusted LVW (the numerical average of the curb weight and the GVWR)

LLDT - light light-duty truck (below 6,000 lbs GVWR)

HLDT - heavy light-duty truck (above 6,000 lbs GVWR)

Table 6.1, Tier 1 Emission Standards

Shortly after, EPA promulgated the Tier 2 program. This program went into effect on April 10, 2000 (65 FR 6698 February 10, 2000) and was phased in between 2004 and 2008. Tier 2 introduced more stringent numerical emission limits compared to the previous program (Tier 1). Tier 2 set a single set of standards for all light duty vehicles. The Tier 2 emission standards are structured into 8 permanent and 3 temporary certification levels of different stringency, called “certification bins”, and an average fleet standard for NO_x emissions. Vehicle manufacturers have a choice to certify particular vehicles to any of the available bins. The program also required refiners to reduce gasoline sulfur levels nationwide, which was fully implemented in 2007. The sulfur levels need to be reduced so that Tier 2 vehicles could run correctly and maintain their effectiveness. The EPA estimated that the Tier 2 program will reduce oxides of nitrogen emissions by at least 2,220,000 tons per year nationwide in 2020[1]. Tier 2 has also contributed in reducing VOC and direct PM emissions from light duty vehicles. Tier 2 standards are summarized in Table 6.2 below.

Tier 2 Emission Standards, FTP 75, g/mi

Bin#	**Full Useful Life**				
	NMOG*	**CO**	**NO_x†**	**PM**	**HCHO**
Temporary Bins					
11 MDPV[c]	0.28	7.3	0.9	0.12	0.032
10[a,b,d]	0.156 (0.230)	4.2 (6.4)	0.6	0.08	0.018 (0.027)
9[a,b,e]	0.090 (0.180)	4.2	0.3	0.06	0.018
Permanent Bins					
8[b]	0.125 (0.156)	4.2	0.2	0.02	0.018
7	0.09	4.2	0.15	0.02	0.018
6	0.09	4.2	0.1	0.01	0.018
5	0.09	4.2	0.07	0.01	0.018
4	0.07	2.1	0.04	0.01	0.011
3	0.055	2.1	0.03	0.01	0.011
2	0.01	2.1	0.02	0.01	0.004
1	0	0	0	0	0

* for diesel fueled vehicle, NMOG (non-methane organic gases) means NMHC (non-methane hydrocarbons)

† average manufacturer fleet NO_x standard is 0.07 g/mi for Tier 2 vehicles

[1] 65 FR 6698 February 10, 2000

a - Bin deleted at end of 2006 model year (2008 for HLDTs)

b - The higher temporary NMOG, CO and HCHO values apply only to HLDTs and MDPVs and expire after 2008

c - An additional temporary bin restricted to MDPVs, expires after model year 2008

d - Optional temporary NMOG standard of 0.280 g/mi (full useful life) applies for qualifying LDT4s and MDPVs only

e - Optional temporary NMOG standard of 0.130 g/mi (full useful life) applies for qualifying LDT2s only

Abbreviations:

LDT2 – light duty trucks 2 (0-6,000 lbs. GVWR, 3,751-5,750 lbs. LVW)

LDT4 – light duty trucks 4 (6,001-8,500 lbs. GVWR, 5,751 lbs. and greater ALVW)

MDPV – medium duty passenger vehicle

HLDT - heavy light duty truck (above 6,000 lbs GVWR)

Table 6.2, Tier 2 Emission Standards

In addition to the benefits from Tier 2 in the current emissions inventories, the emission projections for this SIP from 2014 through 2019 (and beyond) continue to reflect significant improvements in both VOC and NO_x as older vehicles are replaced with Tier 2 vehicles. This trend may be seen in the inventory projections for on-road mobile sources despite the growth in vehicles and vehicle miles traveled that are factored into the same projections.

Additional on-road mobile source emissions improvement stemmed from federal regulations for heavy-duty diesel vehicles. The Highway Diesel Rule, which aimed at reducing pollution from heavy-duty diesel highway vehicles, was finalized in January 2001. Under the rule, beginning in 2007 (with a phase-in through 2010) heavy-duty diesel highway vehicle emissions were required to be reduced by as much 90 percent with a goal of complete fleet replacement by 2030. In order to enable the updated emission-reduction technologies necessitated by the rule, beginning in 2006 (with a phase-in through 2009) refiners were required to begin producing cleaner-burning ultra-low sulfur diesel fuel. Specifically, the rule required a 97 percent reduction in sulfur content from 500 parts per million (ppm) to 15 ppm. The overall nationwide effect of the rule is estimated to be equivalent to removing the pollution from over 90 percent of trucks and buses when the fleet turnover is completed in 2030.

To supplement the federal motor vehicle control program, Inspection / Maintenance (I/M) Programs were implemented in Salt Lake and Davis Counties in 1984. A program for Weber County was added in 1990. These programs have been effective in identifying vehicles that no longer meet the emission specifications for their respective makes and models, and in ensuring that those vehicles are repaired in a timely manner.

Off-road mobile sources:

Several significant regulatory programs enacted at the federal level will affect emissions from non-road mobile emission sources. This category of emitters includes airplanes, locomotives, hand-held engines, and larger portable engines such as generators and construction equipment. The effectiveness of these controls has been incorporated into the “NONROAD” model UDAQ uses to compile the inventory information for this source category. Thus, the controls have been factored into the projection inventories used in the modeled attainment demonstration.

EPA rules for non-road equipment and vehicles are grouped into various "tiers" in a manner similar to the tiers established for on-road motor vehicles. To date, non-road rules have been promulgated for Tiers 0 through IV, where the oldest equipment group is designated "Tier 0" and the newest equipment, some of which has yet to be manufactured, falls into "Tier IV."

Of note are the following:

Locomotives

Locomotive engine regulation began with Tier 0 standards promulgated in 1998, which apply to model year 2001 engines.

In addition, because of the very long lifetimes of these engines, often up to forty years, Tier 0 standards include remanufacturing standards, which apply to locomotive engines of model years 1973 through 2001.

Subsequent tier standards for line-haul locomotives apply as follows:

Tier	Applicable Model Years
Tier I	2002 - 2004
Tier II	2005 - 2011
Tier III	2012 - 2014
Tier IV	2015 - newer

Yard or "switch" locomotives are regulated under different standards than line-haul.

Lastly, EPA has promulgated remanufacturing standards for Tier I and 2 locomotive engines to date.

Large Engines

Large non-road engines are usually diesel-powered but include some gasoline-powered equipment.

Large land-based diesel equipment (> 37 kw or 50 hp) used in agricultural, construction and industrial applications are regulated under Tier I rules, which apply to model years 1996 through 2000. Subsequent Tier II through IV rules apply to newer model-year equipment.

Some large non-road engines are gasoline-powered (spark-ignition). These include equipment such as forklifts, some airport ground support equipment, recreational equipment such as ATVs, motorcycles and snowmobiles. These are regulated under various tiers in a manner similar to diesel equipment.

Small Engines

Small engines are generally gasoline-powered (spark-ignition). Equipment includes handheld and larger non-handheld types. Handheld equipment includes lawn and garden power tools such as shrub trimmers, saws and dust blowers. Non-handheld equipment includes equipment such as lawnmowers and lawn tractors. From an emissions standpoint, smaller engine size is offset by the large number of pieces of equipment in use by households and commercial establishments. This equipment is regulated under a tiered structure as well.

Emissions Benefit

Each major revision of the non-road tier standards results in large reductions in carbon monoxide, hydrocarbons, nitrogen oxides and particulate matter.

For example, the Non-road Diesel Tier II and III Rule, which regulates model-year 2001 through 2008 diesel equipment (> 37 kw or 50 hp) is estimated by EPA, in its Regulatory Announcement for this rule dated August 1998, to decrease NO_x emissions by a million tons per year by 2010, the equivalent of taking 35 million passenger cars off the road.

EPA further estimates, in its Regulatory Announcement dated May 2004, that the Tier IV non-road diesel rule is expected to decrease exhaust emissions per piece of equipment by over 90 percent compared to older equipment.

Low-Sulfur Diesel

Non-road diesel equipment is required to operate on diesel fuel with a sulfur content of no greater than 500 ppm beginning June 1, 2007.

Beginning June 1, 2010, non-road diesel equipment must operate on "ultra-low" sulfur diesel with a sulfur content of no more than 15 ppm.

Locomotives and certain marine engines must operate on ultra-low sulfur diesel by June 1, 2012.

6.5 SIP Controls

Beyond the benefits attributable to the controls already in place, there are new controls identified by this SIP that provide additional benefit toward reaching attainment. A summary of the plan strategy is presented here for each of the emission source sectors.

Overall, the strategy to reduce emissions results in 11.0 tons per day of combined $PM_{2.5}$, SO_2, NO_x and VOC in 2014, and 12.9 tons per day in 2019. Additional reductions of 4.2 tons per day will result from the strategies presented in Section 6.7.

6.6 Reasonably Available Control Measures (RACM/RACT)

Section 172 of the CAA requires that each attainment plan "provide for the implementation of all reasonably available control measures (RACM) as expeditiously as practicable (including such reductions in emissions from existing sources in the area as may be obtained through the adoption, at a minimum, of reasonably available control technology (RACT)), and shall provide for attainment of the NAAQS." EPA interprets RACM as referring to measures of any type that may be applicable to a wide range of sources (mobile, area, or stationary), whereas RACT refers to measures applicable to stationary sources. Thus, RACT is a type of RACM specifically designed for stationary sources. For Both RACT and RACM Potential control measures must be shown to be both technologically and economically feasible.

Pollutants to be addressed by States in establishing RACT and RACM limits in their $PM_{2.5}$ attainment plans will include primary $PM_{2.5}$ as well as any pollutant identified in the plan as a significant contributer to $PM_{2.5}$ formation. For this plan, those pollutants include: SO_2, NO_x and VOC.

In general, the combined approach to RACT and RACM includes the following steps: 1) identification of potential measures that are reasonable, 2) modeling to identify the attainment date that is as expeditious as practicable, and 3) selection of RACT and RACM.

EPA's final rule requires States to conduct an analysis to identify RACT for all affected stationary sources. States can thereafter determine that RACT does not include controls that would not otherwise be necessary to meet Reasonable Further Progress (RFP) requirements or to attain the NAAQS as expeditiously as practicable. Any measures that, collectively, would not advance attainment by at least one year are not required for $PM_{2.5}$ RACT/RACM, even if those measures are individually reasonable. RACT may vary in different nonattainment areas based on the reductions needed for attainment as expeditiously as practicable.

Implementation of RACT measures should be as expeditiously as practicable, but in no case should it start later than the beginning of the year before the nominal attainment date. Furthermore, if the attainment date has been extended, it will be necessary to demonstrate RFP. This means that RACT measures need to be phased in to meet certain milestone goals and cannot all be delayed until the final deadline.

This basic process was applied to each of the four basic sectors of the emissions inventory:

Stationary Point sources:

As stated above, RACT refers to measures applicable to stationary sources. Thus, RACT is a type of RACM specifically designed for stationary sources.

Section 172 does not include any specific applicability thresholds to identify the size of sources that States and EPA must consider in the RACT and RACM analysis. In developing the emissions inventories underlying the SIP, the criteria of 40 CFR 51 for air emissions reporting requirements was used to establish a 100 ton per year threshold for identifying a sub-group of stationary point sources that would be evaluated individually. The cut-off was applied to either a sources reported emissions for 2008 or for its potential to emit in a given year. The rest of the point sources were assumed to represent a portion of the overall area source inventory.

Sources meeting the criteria described above were individually evaluated to determine whether their operations would be considered RACT.

SIPs for $PM_{2.5}$ must assure that the RACT requirement is met, either through a new RACT determination or a certification that previously required RACT controls (e.g. for another pollutant such as PM_{10}) represent RACT for $PM_{2.5}$.

With respect to prior technology determinations other than RACT, the rule provides that prior BACT and LAER determinations, in many cases but not all, would assure at least RACT level controls. Where a State has determined VOC to be a significant contributer to $PM_{2.5}$, compliance with MACT standards may be considered in VOC RACT determinations. EPA anticipates it will be unlikely that States can do much better than what the MACT controls currently require.

Additional information regarding the RACT analysis for each of the sources in the nonattainment area may be found in the Technical Support Document.

For the Salt Lake City, UT nonattainment area, there are 28 stationary point sources that meet the criteria of 100 tons per year for $PM_{2.5}$ or any attainment plan precursor. Emissions from these sources, for the 2008 baseline as well as the projection years 2014, 2017 and 2019 are shown below in Table 6.3. Note that these emissions also include the growth projections that were applied. Information is provided in the TSD regarding the emissions reductions specific to reduction strategies resulting from the SIP.

Typical Winter Inversion Weekday Emissions (tpd)			2008_E10_R9DM3 080212 Baseline					2014_E10_R21DM3 081012 Growth & Control				
Source Category	NA-Area	Site	PM2_5	NOX	VOC	NH3	SOX	PM2_5	NOX	VOC	NH3	SOX
Point Sources	Salt Lake City, UT											
		ATK Thiokol Promontory	0.179	0.424	0.141	0.002	0.043	0.190	0.451	0.149	0.003	0.045
		Bountiful City Power	0.001	0.002	0.000		0.000	0.087	0.216	0.051		0.002
		Central Valley Water	0.004	0.034	0.137	0.000	0.003	0.004	0.033	0.032	0.000	0.003
		CER Generation II LLC - WVC	0.015	0.039	0.005		0.002	0.015	0.038	0.005		0.002
		Chemical Lime Company	0.126	0.141	0.006	0.000	0.035	0.164	0.185	0.008	0.000	0.046
		Chevron Refinery	0.462	2.752	0.607	0.024	1.655	0.102	0.931	1.219	0.022	0.068
		Clean Harbors Aragonite	0.008	0.362	0.016	0.000	0.089	0.013	0.595	0.026	0.000	0.148
		Clean Harbors Grassy Mountain	0.006	0.025	0.006		0.002	0.008	0.032	0.008		0.002
		Deseret Chemical Depot	0.015	0.255	0.024	0.000	0.029	0.016	0.279	0.026	0.000	0.031
		Dugway	0.109	0.148	0.063	0.001	0.092	0.121	0.162	0.070	0.001	0.100
		Flying J Refinery	0.172	0.658	1.276	0.309	1.053	0.160	0.634	1.243	0.298	1.040
		Geneva Rock Point of Mountain	0.071	0.275	0.051		0.038	0.082	0.303	0.059		0.025
		Great Salt Lake Minerals - Production Plant	0.125	0.241	0.021	0.002	0.017	0.101	0.363	0.058	0.003	0.024
		Hexcel Corporation Salt Lake Operations	0.047	0.245	0.170	0.072	0.025	0.091	0.323	0.323	0.129	0.047
		Hill Air Force Base Main	0.032	0.465	0.731	0.005	0.007	0.035	0.513	0.799	0.005	0.008
		Hill Air Force Base UTTR	0.090	0.041	0.014	0.006	0.000	0.096	0.044	0.015	0.007	0.000
		Holly Refining Marketing	0.145	0.844	0.622	0.057	1.306	0.118	0.822	0.575	0.052	0.179
		Interstate Brick Brick	0.158	0.105	0.009		0.034	0.209	0.137	0.012		0.044
		Kennecott Mine Concentrator	0.683	8.712	0.516	0.004	0.008	0.829	12.130	0.639	0.005	0.014
		Kennecott NC-UPP-Lab-Tailings	0.036	0.018	0.006	0.001	0.000	0.035	0.017	0.006	0.001	0.000
		Kennecott Smelter & Refinery	0.563	0.472	0.027	0.014	2.759	0.774	0.723	0.055	0.019	3.679
		Murray City Power	0.000	0.005	0.000		0.000	0.000	0.005	0.000		0.000
		Nucor Steel	0.162	0.502	0.202	0.006	0.118	0.205	0.652	0.260	0.008	0.160
		Olympia Sales Co.	0.013	0.001	0.057	0.000	0.000	0.000	0.001	0.076	0.000	0.000
		Pacificorp Gadsby	0.069	0.459	0.033	0.065	0.007	0.067	0.292	0.023	0.065	0.007
		Pacificorp Little Mountain	0.021	1.014	0.007		0.011					
		Proctor & Gamble Paper Products Co.						0.559	0.643	0.646		0.007
		Silver Eagle Refining	0.012	0.246	0.358	0.012	0.003	0.011	0.245	0.354	0.012	0.003
		Tesoro Refinery	0.655	1.069	0.748	0.010	2.517	0.653	1.051	0.744	0.010	2.506
		University of Utah	0.022	0.291	0.021	0.008	0.003	0.041	0.215	0.013	0.006	0.002
		US Magnesium	0.653	2.849	1.101	0.006	0.036	0.862	3.719	1.468	0.008	0.047
		Utility Trailer	0.002	0.116	0.154		0.001	0.002	0.142	0.183		0.001
		Vulcraft	0.012	0.015	0.107	0.000	0.001	0.022	0.022	0.144	0.000	0.001
		Wasatch Integrated IE	0.017	0.800	0.025	0.033	0.259	0.023	1.099	0.036	0.046	0.360
		Salt Lake City, UT Total	**4.683**	**23.624**	**7.261**	**0.641**	**10.151**	**5.695**	**27.016**	**9.325**	**0.700**	**8.602**

Typical Winter Inversion Weekday Emissions (tpd)			2017_E10_R1DM3 082112 Growth & Control					2019_E10_R36DM3 081012 Growth & Control				
Source Category	NA-Area	Site	PM2_5	NOX	VOC	NH3	SOX	PM2_5	NOX	VOC	NH3	SOX
Point Sources	Salt Lake City, UT											
		ATK Thiokol Promontory	0.195	0.462	0.153	0.003	0.046	0.196	0.477	0.155	0.003	0.047
		Bountiful City Power	0.087	0.216	0.051		0.002	0.087	0.216	0.051		0.002
		Central Valley Water	0.004	0.033	0.032	0.000	0.003	0.004	0.033	0.032	0.000	0.003
		CER Generation II LLC - WVC	0.015	0.038	0.005		0.002	0.015	0.038	0.005		0.002
		Chemical Lime Company	0.184	0.208	0.009	0.000	0.052	0.201	0.227	0.010	0.000	0.057
		Chevron Refinery	0.102	0.931	1.219	0.022	0.068	0.102	0.931	1.219	0.022	0.068
		Clean Harbors Aragonite	0.015	0.718	0.032	0.000	0.185	0.017	0.819	0.036	0.000	0.198
		Clean Harbors Grassy Mountain	0.009	0.037	0.009		0.002	0.009	0.040	0.009		0.003
		Deseret Chemical Depot	0.016	0.289	0.027	0.000	0.032	0.017	0.293	0.027	0.000	0.033
		Dugway	0.123	0.168	0.071	0.001	0.103	0.126	0.170	0.072	0.001	0.105
		Flying J Refinery	0.160	0.634	1.243	0.298	1.040	0.087	0.492	0.841	0.298	0.633
		Geneva Rock Point of Mountain	0.082	0.304	0.060		0.026	0.084	0.316	0.060		0.026
		Great Salt Lake Minerals - Production Plant	0.110	0.396	0.062	0.003	0.027	0.116	0.418	0.066	0.003	0.028
		Hexcel Corporation Salt Lake Operations	0.092	0.483	0.342	0.165	0.089	0.093	0.585	0.357	0.190	0.118
		Hill Air Force Base Main	0.037	0.537	0.840	0.006	0.008	0.037	0.560	0.873	0.006	0.009
		Hill Air Force Base UTTR	0.097	0.044	0.015	0.007	0.000	0.098	0.045	0.015	0.007	0.000
		Holly Refining Marketing	0.118	0.822	0.575	0.052	0.179	0.118	0.822	0.575	0.052	0.179
		Interstate Brick Brick	0.227	0.154	0.013		0.050	0.254	0.166	0.014		0.053
		Kennecott Mine Concentrator	0.719	12.125	0.602	0.004	0.012	0.390	5.512	0.289	0.003	0.008
		Kennecott NC-UPP-Lab-Tailings	0.212	0.194	0.066	0.001	0.033	0.212	0.194	0.066	0.001	0.033
		Kennecott Smelter & Refinery	0.871	0.797	0.061	0.021	4.077	0.927	0.864	0.066	0.023	4.342
		Murray City Power	0.000	0.005	0.000		0.000	0.000	0.005	0.000		0.000
		Nucor Steel	0.224	0.697	0.278	0.008	0.161	0.242	0.744	0.298	0.009	0.173
		Olympia Sales Co.	0.000	0.001	0.063	0.000	0.000	0.000	0.002	0.067	0.000	0.000
		Pacificorp Gadsby	0.067	0.292	0.023	0.065	0.007	0.042	0.138	0.014	0.054	0.005
		Pacificorp Little Mountain										
		Proctor & Gamble Paper Products Co.	0.611	0.713	0.688		0.008	0.659	0.759	0.753		0.008
		Silver Eagle Refining	0.011	0.075	0.294	0.004	0.003	0.011	0.075	0.294	0.004	0.003
		Tesoro Refinery	0.275	1.167	0.852	0.010	2.127	0.085	0.729	0.796	0.010	0.513
		University of Utah	0.040	0.191	0.012	0.005	0.002	0.041	0.194	0.012	0.005	0.002
		US Magnesium	0.980	4.306	1.653	0.009	0.054	1.070	4.629	1.835	0.010	0.059
		Utility Trailer	0.002	0.143	0.198		0.001	0.002	0.156	0.201		0.001
		Vulcraft	0.027	0.027	0.176	0.000	0.002	0.032	0.031	0.200	0.000	0.002
		Wasatch Integrated IE	0.026	1.230	0.040	0.052	0.394	0.027	1.325	0.043	0.055	0.427
		Salt Lake City, UT Total	**5.740**	**28.436**	**9.764**	**0.736**	**8.794**	**5.400**	**22.002**	**9.352**	**0.757**	**7.140**

Table 6.3, Point Source Emissions; Baseline and Projections with Growth and Control

<u>Area sources:</u>

As part of the RACT analysis for area sources, consideration was given to a broad list of source categories. Table 6.4 identifies these categories as well as the pollutant(s) likely to be controlled, and provides some remarks as to whether a control strategy was ultimately pursued. In considering what source categories might be considered, Utah made use of EPA recommendations as well as control strategies from other states. DAQ evaluated each strategy for technical feasibility as part of the RACT analysis. The screening column in table 6.4 identifies whether or not a strategy was retained for rulemaking or screened out for impracticability.

Table 6.4 Area Source Strategy Screening

Strategy	**Constituent(s)**	**SCREENING STATUS**	**REMARKS**
1. Repeal current surface coating rule, R307-340. Replace this rule with individual rules for each category. New rules include	VOC	Retained	R307-340 currently applies to Davis and Salt Lake counties. R307-340 will be withdrawn and re-enacted as separate rules for each existing category. The new rules will be

Strategy	Constituent(s)	SCREENING STATUS	REMARKS
$PM_{2.5}$ nonattainment areas. New rules update applicability and control limits to most current CTG. Current rule includes: a. Paper b. Fabric and vinyl c. Metal furniture d. Large appliance e. Magnet wire f. Flat wood g. Miscellaneous metal parts h. Graphic arts			expanded to nonattainment areas.
2. New separate surface coating rules for following sources: a. High performance b. Architectural c. Aircraft d. Marine e. Sheet, strip & coil f. Traffic markings g. Plastic parts	VOC	See Remarks Column	High performance – screened, regulated under Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) Architectural – screened, research indicates that reducing VOC levels further would result in limited use coating that would not be practical for residential and commercial use Aircraft – retained as new aerospace rule Marine – screened, only 1.2 tpy

Strategy	Constituent(s)	SCREENING STATUS	REMARKS
			Sheet, strip & coil – retained as new rule Traffic markings - screened, regulated under FIFRA Plastic parts - retained as new rule
3. Agricultural practices using Natural Resources Conservation Service conservation practice standards	VOC, $PM_{2.5}$, ammonia	Screened	Complicated programs, difficult to implement in Utah livestock operations, limited use options in winter time with low control efficiency
4. Over the counter consumer products rule regulating VOC content of pesticide, automotive products etc.	VOC	Screened	Various federal regulations address these products
5. Over the counter for personal care and household products rule	VOC	Screened	Various federal regulations address these products
6. Adhesives and sealant rule	VOC	Screened	Various federal regulations address these products
7. Expand current solvent degreasing rule R307-335 to $PM_{2.5}$ nonattainment areas and add a new section on industrial solvent cleaning	VOC	Retained	
8. New automobile refinishing rule	VOC	Retained	
9. Expand wood furniture manufacturing rule to $PM_{2.5}$ nonattainment areas and update to most current CTG.	VOC	Retained	
10. Lower the red-day cut point for residential use of fireplaces and	VOC, $PM_{2.5}$, NO_x, SO_x,	Retained	

Strategy	Constituent(s)	SCREENING STATUS	REMARKS
wood stoves. Require EPA certified stoves and prohibit the sale/resale of noncertified stoves in nonattainment areas.	ammonia		
11. Ban new sales of outdoor wood boilers	VOC, $PM_{2.5}$, NO_x, SO_x, ammonia	Retained	
12. Industrial bakery rule	VOC	Retained	
13. Chain-driven charbroiler restaurant emission control	VOC, $PM_{2.5}$	Retained	
14. Pilot light phase out in gas fireplaces, stoves and home heaters	VOC, $PM_{2.5}$, NO_x, SO_x, ammonia	Retained	
15. Expand current fugitive dust rule, R307-309 to $PM_{2.5}$ nonattainment areas. Require BMP's for dust plans.	$PM_{2.5}$	Retained	
16. Amend fugitive dust rule to include cattle feed lot	$PM_{2.5}$	Screened	Feed lots are not located in nonattainment areas
17. Low NO_x burners in commercial and institutional water heaters	VOC, NO_x	Screened	NO_x reduction impairing attainment of $PM_{2.5}$
18. Chemical additives to manure	VOC, ammonia	Screened	Costly with limited control efficiency. Excess ammonia in inventory that would not be sufficient to be effective
19. Ban testing of back-up generators on red-alert days	VOC, $PM_{2.5}$, NO_x, SO_x	Retained	
20. Prohibit use of cutback asphalt	VOC	Screened	Cities and highway administration personnel need stockpile for winter time road repair. Very small inventory.
21. Control limits on aggregate processing operations	$PM_{2.5}$	Retained	

Strategy	Constituent(s)	SCREENING STATUS	REMARKS
22. R307-307 Road Salt and Sanding	PM	Retained	Expand current rule to nonattainment areas

EPA has developed control measure guidance documents called, control techniques guidelines (CTGs) for volatile organic compounds (VOCs). CTGs are used as presumptive RACT for VOCs and are guidance in SIP rulemaking. DAQ has evaluated all VOC CTGs for area sources as part of the SIP process.

As noted above, many CTGs were previously adopted into Utah's air quality rules to address ozone nonattainment in Salt Lake and Davis Counties. In conducting this evaluation, consideration was given to whether an expansion of applicability for an existing CTG into additional counties would provide a benefit for $PM_{2.5}$, and whether a strengthening of existing CTG requirements in Salt Lake and Davis Counties would result in an incremental benefit that was economically feasible. Furthermore, EPA has updated some of its existing CTGs and added some new ones to the list.

As part of this SIP, Utah has identified relevant source categories covered by CTGs, and assembled draft rules, based on these CTGs, for reducing emissions from these categories. These rules will apply to the following source categories:

- Control of Volatile Organic Emissions from Surface Coating of Cans, Coils, Paper, Fabrics, Automobiles, and Light-Duty Trucks
- Control of Volatile Organic Emissions from Solvent Metal Cleaning
- Control of Volatile Organic Emissions from Surface Coating of Insulation of Magnet Wire
- Control of Volatile Organic Emissions from Graphic Arts
- Control of Volatile Organic Compound Emissions from Wood Furniture Manufacturing Operations
- Control Techniques Guidelines for Industrial Cleaning Solvents
- Control Techniques Guidelines for Flat Wood Paneling Coatings
- Control Techniques Guidelines for Paper, Film, and Foil Coatings
- Control Techniques Guidelines for Large Appliance Coatings
- Control Techniques Guidelines for Metal Furniture Coatings
- Control Techniques Guidelines for Miscellaneous Metal and Plastic Parts Coatings
- Control of Volatile Organic Emissions from Coating operations at Aerospace manufacturing and Rework Operations
- Alternative Control Technology Document – Bakery Ovens

While most VOC sources are addressed by CTGs, the remaining emission sources must be evaluated by engineering analysis, including an evaluation of rulings by other states. These include VOCs from autobody refinishing, restaurant charbroiling, and phasing out appliance pilot lights.

CTGs for $PM_{2.5}$ emissions sources do not exist. RACT for $PM_{2.5}$ has been established through information from varied EPA and other state SIP sources. A useful source of data is the AP 42 Compilation of Air Pollutant Emission Factors, first published by the US Public Health Service in 1968. In 1972, it was revised and issued as the second edition by the EPA. The emission factor/control information was applied to fugitive dust and mining strategies.

Table 6.5 shows the effectiveness of the area source SIP control strategy for the Salt Lake City, UT nonattainment area. Each of these rules would become effective prior to January 1, 2014.

Salt Lake City, UT Nonattainment Area	2014 lb/day					2019 lb/day				
	NH3	NOX	PM2_5	SO2	VOC	NH3	NOX	PM2_5	SO2	VOC
Area Source Rules										
R307-347, large appliance coating	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	1.8
R307-354, Auto body refinishing	0.0	0.0	0.0	0.0	2,640.2	0.0	0.0	0.0	0.0	2,859.6
R307-335, Degreasing	0.0	0.0	0.0	0.0	3,273.6	0.0	0.0	0.0	0.0	3,432.7
R307-309, Fugitive dust	0.0	0.0	193.1	0.0	0.0	0.0	0.0	186.3	0.0	0.0
R307-351, Graphic arts	0.0	0.0	0.0	0.0	1,957.7	0.0	0.0	0.0	0.0	1,957.7
R307-350 Miscellaneous metal parts coating										
machinery	0.0	0.0	0.0	0.0	146.6	0.0	0.0	0.0	0.0	155.7
other transportation	0.0	0.0	0.0	0.0	544.2	0.0	0.0	0.0	0.0	606.5
Special	0.0	0.0	0.0	0.0	5.0	0.0	0.0	0.0	0.0	5.7
R307-352, Metal containers	0.0	0.0	0.0	0.0	211.6	0.0	0.0	0.0	0.0	240.2
R307-346, Metal furniture coating	0.0	0.0	0.0	0.0	96.8	0.0	0.0	0.0	0.0	101.8
R307-312, Aggregate processing operations	0.0	0.0	2.1	0.0	0.0	0.0	0.0	1.8	0.0	0.0
R307-344, Paper, film & foil coating	0.0	0.0	0.0	0.0	1,242.6	0.0	0.0	0.0	0.0	1,297.0
R307-356, Pilot light	130.3	612.8	2.8	3.9	35.8	618.3	2,906.4	13.3	18.6	170.1
R307-353, Plastic coating & R307-345 Fabric & vinyl coating	0.0	0.0	0.0	0.0	1,408.6	0.0	0.0	0.0	0.0	1,483.2
R307-303, Commercial cooking	0.0	0.0	341.2	0.0	88.1	0.0	0.0	369.8	0.0	95.4
R307-352, Sheet & coil coating	0.0	0.0	0.0	0.0	2,571.7	0.0	0.0	0.0	0.0	2,707.3
R307-348, Magnet wire coating	0.0	0.0	0.0	0.0	9.7	0.0	0.0	0.0	0.0	10.8
R307-349, Flat wood panel coating	0.0	0.0	0.0	0.0	46.3	0.0	0.0	0.0	0.0	49.1
R307-302, Solid fuel burning	0.0	49.2	512.6	7.5	933.2	0.0	62.1	647.2	9.5	1,178.6
R307-343, Wood manufacturing	0.0	0.0	0.0	0.0	1,991.1	0.0	0.0	0.0	0.0	2,134.6
R307-334, Industrial baking ovens	0.0	0.0	0.0	0.0	860.2	0.0	0.0	0.0	0.0	933.1
TOTAL	**130.3**	**662.0**	**1,051.9**	**11.4**	**18,064.7**	**618.3**	**2,968.5**	**1,218.4**	**28.0**	**19,420.8**

Table 6.5, Emissions Reductions from Area Source SIP Controls

On-road mobile sources:

A decentralized, test-and-repair program was evaluated for Box Elder and Tooele counties within the nonattainment area. For the evaluation, all model year 1968 and newer vehicles would be subject to a biennial test except for exempt vehicles. The program would exempt vehicles less than four years old as of January 1 on any given year from an emissions inspection. Year 1996 and newer vehicles would be subject to an On-Board Diagnostics (OBD) inspection. Year 1995 and older vehicles would be subject to a two-speed idle inspection (TSI). Based on this evaluation, this program was not included because it was determined that implementation of such a program would not affect PM 2.5 concentrations at the controlling monitor (i.e. Hawthorne) for the Salt Lake-Ogden-Clearfield nonattainment area.

Off-road mobile sources:

Beyond the existing controls reflected in the projection-year inventories and the air quality modeling there are no emission controls that would apply to this source category.

6.7 Additional SIP Controls

Additional work on source categories will continue through the development of additional SIP controls listed in Table 6.6. Potential emissions reductions associated with these candidate measures are not currently quantifiable. Further study of these candidate control measures will provide the background necessary to determine which of these measures would be implemented in future years to achieve additional reductions if needed for attainment, contingency, or continued maintenance of the $PM_{2.5}$ NAAQS.

UDAQ is also continuing its discussions with EPA on RACT/RACM determinations, and will consider public input during the SIP development process.

Results of these feasibility studies will be made available by the completion dates also shown in the table. Studies that point toward possible emission reductions opportunities will be incorporated into the plan with specific development schedules and emission reductions commitments.

Study	Description	Implemented By		Pollutant Reduced				Study Completion Date
		State	County	PM	VOC	NO_x	SO_2	
Track Out	Better Enforcement of current road cleaning requirements when track out occurs	√	√	√				TBD*
RVP	Lowering the Reid Vapor Pressure of gasoline sold in the nonattainment area	√			√			TBD*
Boiler Rule	Requiring Lo-NO_x Burners or other NO_x Controls on new and/or existing boilers/furnaces	√				√		TBD*

Indirect Sources	Requiring controls on projects that attract or make possible pollution increases in hot-spot areas - like parking lots attract cars and affect traffic flow	√		√	√			TBD*
Transportation Control Measures (TCMs)	Either specifying that a certain traffic control measure will be implemented, or creating an on-road mobile budget lower than current growth projections predict to encourage the development of appropriate TCMs	√	√	√	√	√		TBD*
Wood-burning Ban	Ban the use of solid-fuel burning devices - indoor and outdoor - for the entire $PM_{2.5}$ winter season	√	√	√	√			TBD*
Flare Gas Recovery	Requiring that refineries send gasses normally flared to a recovery chamber where they are either burned with controls applied, or recycled to other refinery operations such as a reformer	√		√	√		√	TBD*
Forward-Looking Infra Red (FLIR)	Used as an enforcement tool to identify VOC emissions generally from leaks in refineries	√			√			TBD*
Tiered RACT	Incrementally lowering the threshold for the size of point sources for whom RACT is applied (currently 100 tons/year). For example, sources from 75-99 t/y, then 50-74 t/y, then 25-49 t/y.	√		√	√		√	TBD*
Grand-fathered Sources	As part of Tiered RACT, sources previously "grandfathered" would have to apply appropriate controls	√	√	√	√		√	TBD*
Intermittent Controls	Actions that can be taken during yellow- and red-burn periods to avoid exceeding the NAAQS, but do not need to be applied during green-burn periods	√	√	√	√	√	√	TBD*

Mandatory trip-reduction plans	Employers of > 100 employees provide plans to reduce drive-alone rates and reduce employee commuting	√	√	√	√	√		TBD*
Voluntary Measures	Work with the public and sources to identify actions they can take during yellow- and red-burn days to avoid exceeding the NAAQS	√	√	√	√			TBD*

* Note: Dates for Study Completion will be set following comment period with commenter input

Table 6.6, Additional SIP Controls Identified for Feasibility Studies

As shown in the Attainment Demonstration section of the plan (Chapter 5), the Salt Lake City, UT nonattainment area will require a full 5-year extension of the attainment date to reach attainment, and in addition will require further reductions in emissions by that time in order to meet the NAAQS.

For the purposes of implementing this plan, UDAQ is committed to developing and implementing control measures that will achieve, in aggregate, the emissions reductions specified below, or equivalent (as determined by the air quality model). These reductions have been expressed as 1.2 tons per day of $PM_{2.5}$ emissions and 3.0 tons per day of VOC emissions. Nevertheless, there are other combinations of emissions reductions that could also result in predicted $PM_{2.5}$ concentrations that meet the NAAQS by the attainment date of January 1, 2020.

The measures identified in Table 6.6 are categorized and discussed in more detail below.

<u>Stationary Point sources:</u>

UDAQ is currently evaluating the following additional control strategies for stationary point sources:

Incrementally lowering the threshold for the size of point sources for whom RACT is applied (currently 100 tons/year). Sources above the 100 ton per year threshold were given individual attention in the RACT analysis for the SIP. By incrementally lowering this threshold, UDAQ will likely identify additional emissions that can be reduced through the application of RACT.

Requiring Lo-NO_x Burners or other NO_x Controls on new and/or existing boilers/furnaces. This is actually but one of several rules affecting stationary point sources that can be further developed with more time.

<u>Area sources:</u>

Area source emissions include sources that are individually so small that they may not be included in state survey information. These small sources may not individually emit significant amounts of pollutants, but when aggregated can make an appreciable contribution to the emission inventory. Utah's commitment to meeting attainment includes conducting future analysis of these small sources to determine whether further VOC reductions can be feasibly attained from these sources. DAQ will use

Utah the Workforce Services industry and commerce database to reconcile sources with the DAQ area source inventory. We will evaluate industry types and size, than consider whether RACT rulemaking is feasible.

<u>On-road mobile sources:</u>

UDAQ is currently evaluating the following additional control strategies for on-road mobile sources:

Reduction in the Reid vapor pressure (RVP) of gasoline: UDAQ is currently working with the Utah petroleum refining industry and other fuel suppliers to evaluate the effectiveness of seeking a mandatory or voluntary reduction in the Reid vapor pressure (RVP) of gasoline, thereby making the fuel less volatile and helping to reduce VOC emissions. In preliminary modeling, this strategy has been shown to reduce total inventory VOC emissions between 0.3 and 0.5 percent. UDAQ will continue to evaluate this control strategy.

Voluntary and emerging mobile source strategies: EPA guidance allows up to 3 percent of the total reduction required to achieve attainment to come from voluntary and emerging mobile source strategies. Examples of such strategies include, but are not limited to:

- trip reduction programs
- alternative fuels
- diesel retrofits
- episode-triggered/inversion-specific measures

UDAQ will work with the WFRC and other stakeholders to assess various voluntary and emerging strategies for their emissions reduction potential in the SLC, UT nonattainment area. Specific strategies and their associated characteristics (e.g. responsibility for implementation, funding sources, statutory or rule-making requirements, and other details) have not yet been specified and would need to be developed in consultation with relevant agencies, authorities, and stakeholders.

<u>Off-road mobile sources:</u>

UDAQ is currently evaluating the following additional control strategies for nonroad mobile sources:

Nonroad Construction Equipment: UDAQ is exploring opportunities to accelerate adoption of cleaner nonroad construction equipment. Currently, nonroad construction equipment accounts for more than 50 percent of PM and NO_x emissions from all nonroad engines. Table 6.7 shows the 2008 Annual Nonroad inventory along Utah's Wasatch Front in tons per year.

	VOC	PM_{10} exhaust	$PM_{2.5}$ exhaust	CO exhaust	NO_x exhaust	CO_2 exhaust	SO_2 exhaust
All Nonroad	5,522.4	640.2	613.5	62,481.8	7,520.9	882,511.3	24.6
All Construction Equip	575.7	342.7	331.8	4,708.8	3,963.4	439,506.9	11.6
Construction Eqp/All Nonroad	10.4%	53.5%	54.1%	7.5%	52.7%	49.8%	47.2%

Table 6.7, 2008 Annual Nonroad Emissions Wasatch Front Inventory (tons/year)

Adoption of Tier 4 emissions standards will reduce PM and NO_x from nonroad diesel construction equipment by 50 percent between 2008 and 2015: One approach to accelerating the adoption of clean nonroad construction equipment is to develop a rule governing equipment sales – e.g. requiring Tier 4 emissions standards. Alternatively, an incentive-based approach could be utilized, such as granting preferential treatment to contractors utilizing construction equipment with the most up-to-date emissions controls in State construction projects. Such an approach might be coupled with diesel retrofit incentives or other clean technology incentives to help contractors update their fleets/equipment.

Small Engine Buyback Program: UDAQ is evaluating the creation of a small gasoline engine buy-back program to accelerate the adoption of cleaner technology into the marketplace. In 2008, EPA finalized emission standards for new nonroad spark-ignition engines with a goal of reducing hydrocarbon emissions from these sources by 35 percent. This equipment began to be available in the marketplace between 2011 and 2012, but -- since consumers may use small engines for several years -- it will take some time before the new, cleaner engines are widely in use. A buyback or other incentive program could be developed to accelerate the adoption of cleaner small engine technology. UDAQ is currently exploring options for the creation of such a program as well as evaluating the efficacy of such a program in reducing emissions.

6.8 Conclusions on Control Measures

Modeling predictions confirm that meeting the 2006 24-hour standard for $PM_{2.5}$ in the Salt Lake City, UT nonattainment area will be a serious challenge. Stationary sources are already heavily controlled, and represent less than 20% of the overall inventory in 2019. More stringent tail-pipe standards for new vehicles will not produce reductions until the old engines are replaced with cleaner new engines.

Projections show that emission reductions from Tier II motor vehicle control, improvements in nonroad emission standards, the area source SIP control measures, and stationary source RACT control are barely sufficient to bring the area into attainment by 2019.

Additional work on the development of additional SIP controls will continue however, for the purpose of identifying potential reductions for attainment, contingency, or continued maintenance of the $PM_{2.5}$ NAAQS.

Chapter 7 – TRANSPORTATION CONFORMITY

7.1 Introduction

The federal Clean Air Act (CAA) requires that transportation plans and programs within the Salt Lake City, Utah $PM_{2.5}$ nonattainment area conform to the air quality plans in the region prior to being approved by the Wasatch Front Regional Council Metropolitan Planning Organization (WFRC). Demonstration of transportation conformity is a condition to receive federal funding for transportation activities that are consistent with air quality goals established in the Utah State Implementation Plan (SIP). The CAA regulates air pollutant emissions from mobile sources by establishing motor vehicle emissions budgets in the SIP. Transportation conformity requirements are intended to ensure that transportation activities do not interfere with air quality progress. Conformity applies to on-road mobile source emissions from regional transportation plans (RTPs), transportation improvement programs (TIPs), and projects funded or approved by the Federal Highway Administration (FHWA) or the Federal Transit Administration (FTA) in areas that do not meet or previously have not met the National Ambient Air Quality Standards (NAAQS) for ozone, carbon monoxide, particulate matter less than ten micrometers in diameter (PM_{10}), particulate matter 2.5 micrometers in diameter or less ($PM_{2.5}$), or nitrogen dioxide.

The Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users (SAFTEA-LU) and section 176(c)(2)(A) of the CAA require that all regionally significant highway and transit projects in air quality nonattainment areas be derived from a "conforming" transportation plan. Section 176(c) of the CAA requires that transportation plans, programs, and projects conform to applicable air quality plans before being approved by an MPO. Conformity to an implementation plan means that proposed activities must not (1) cause or contribute to any new violation of any standard in any area, (2) increase the frequency or severity of any existing violation of any standard in any area, or (3) delay timely attainment of any standard or any required interim emission reductions or other milestones in any area.

The plans and programs produced by the transportation planning process of the WFRC are required to conform to the on-road mobile source emissions budgets established in the SIP. Approval of conformity is determined by the FHWA and FTA.

7.2 Consultation

The Interagency Consultation Team (ICT) is an air quality workgroup in Utah that makes technical and policy recommendations regarding transportation conformity issues related to the SIP development and transportation planning process. Section XII of the SIP established the ICT workgroup and defines the roles and responsibilities of the participating agencies. Members of the ICT workgroup collaborated on a regular basis during the development of the $PM_{2.5}$ SIP. They also meet on a regular basis regarding transportation conformity and air quality issues. The ICT workgroup is comprised of management and technical staff members from the affected agencies associated directly with transportation conformity.

ICT Workgroup Agencies

- Utah Division of Air Quality (UDAQ)
- Metropolitan Planning Organizations MPOs
    - Cache MPO
    - Wasatch Front Regional Council
    - Mountainland Association of Governments
- Utah Department of Transportation (UDOT)
- Utah Local Public Transit Agencies
- Federal Highway Administration (FHWA)
- Federal Transit Administration (FTA)
- U.S. Environmental Protection Agency (EPA)

7.3 Regional Emission Analysis

The regional emissions analysis is the primary component of transportation conformity and is administered by the lead transportation agency located in the EPA designated air quality nonattainment area. On December 2009 EPA designated all of Davis and Salt Lake Counties and parts of Box Elder, Tooele, and Weber as the Salt Lake City, Utah $PM_{2.5}$ nonattainment area. The responsible transportation planning organization for the Utah Salt Lake City nonattainment area is covered the Wasatch Front Regional Council (WFRC) .

The motor vehicle emissions budget serves as a regulatory limit for on-road mobile source emissions. Motor vehicle emissions limits are defined in 40 CFR 93.101 as "that portion of the total allowable emissions defined in the submitted or approved control strategy implementation plan revision or maintenance plan for a certain date for the purpose of meeting reasonable further progress milestones or demonstrating attainment or maintenance of the NAAQS, for any criteria pollutant or its precursors, allocated to highway and transit vehicle use and emissions." As a condition to receive federal transportation funding, transportation plans, programs, and projects are required to meet those emission budgets through strategies that increase the efficiency of the transportation system and reduce motor vehicle use.

The conformity test consists of either an interim emissions test or a motor vehicle emissions budgets test. The interim conformity test requirements apply until either EPA has declared the motor vehicle emissions budgets adequate for transportation conformity purposes or until EPA approves the $PM_{2.5}$ SIP.

7.4 Interim $PM_{2.5}$ Conformity Test

The EPA interim conformity test for $PM_{2.5}$ emissions requires that future nitrogen oxides (NO_x) and directly emitted $PM_{2.5}$ emissions from RTPs, TIPs, and projects funded or approved by the FHWA or the FTA not exceed 2008 levels. NO_x emissions are a gaseous $PM_{2.5}$ precursor emissions emitted from vehicle exhaust related emissions. Primary particulate emissions consist of particles emitted from vehicle exhaust (elemental carbon, organic carbon, and SO_4) and brake and tire wear. The Interim conformity test requirements apply until EPA has declared the motor vehicle emissions budgets adequate for transportation conformity purposes or until it approves the $PM_{2.5}$ SIP.

7.5 Transportation $PM_{2.5}$ Budget Test Requirements

The WFRC collaborated with the ICT workgroup on interim conformity and SIP related issues prior to receiving the official EPA designation status of nonattainment for $PM_{2.5}$. During the SIP development process the WFRC coordinated with the ICT workgroup and developed $PM_{2.5}$ SIP motor vehicle emissions budgets using the latest planning assumptions and tools for traffic analysis and the EPA approved Motor Vehicle Emission Simulator (MOVES) emissions model. Local MOVES modeling data inputs were cooperatively developed by WFRC and the ICT workgroup using EPA recommended methods where applicable.

7.6 Transportation Conformity $PM_{2.5}$ components

The transportation conformity requirements found in 40 CFR 93.102 require that the $PM_{2.5}$ SIP include motor vehicle emissions budgets for directly emitted $PM_{2.5}$; motor vehicle emissions from tailpipe, brake and tire wear; and emissions of nitrogen oxide (NO_x), a gaseous $PM_{2.5}$ precursor. Because UDAQ has identified volatile organic compounds (VOCs) as a $PM_{2.5}$ precursor that significantly impact $PM_{2.5}$ concentrations, the SIP will need a VOC motor vehicle emissions budget for transportation conformity purposes. The EPA conformity rule presumes that $PM_{2.5}$ re-entrained road dust does not need to be included in the interim conformity test or have an established motor vehicle emissions budget unless either the State or EPA decides that re-entrained road dust emissions are a significant contributor to the $PM_{2.5}$ nonattainment problem. The UDAQ conducted a re-entrained road dust study that concluded that $PM_{2.5}$ re-entrained road dust emissions are negligible in the Salt Lake City, Utah $PM_{2.5}$ nonattainment area and meet the criteria of 40 CFR 93.102(b)(3). EPA Region 8 reviewed the study and concurred with the UDAQ's findings.

Currently the UDAQ is in negotiations with EPA Region 8 regarding the establishment of a direct $PM_{2.5}$ budget in the transportation conformity budget section of the SIP.

The State of Utah has concluded that only NO_x and VOC emissions from on-road motor vehicles warrant consideration for potential emission reduction controls to peak $PM_{2.5}$ levels in the nonattainment areas.

7.7 Transportation Conformity $PM_{2.5}$ Budgets

This plan includes reasonable further progress demonstrations for 2014 and 2017 and attainment of the $PM_{2.5}$ standard is projected by 2019. Transportation conformity budgets have been established for the years 2014, 2017, and 2019.

In this SIP, the State is establishing transportation conformity motor vehicle emission budgets (MVEB) for NO_x and VOC for 2014, 2017, and 2019.

WFRC Transportation Conformity Budgets

(tons per average winter day)

	Direct PM2.5	NOx	VOC
2014	TBD	80	47.5
2017	TBD	67	40.1
2019	TBD	55.2	32.6

Table 7.1, Emissions Budgets for Transportation Conformity Purposes

Chapter 8 – REASONABLE FURTHER PROGRESS

8.1 Introduction

Clean Air Act Section 172(c)(2) requires that plans for nonattainment areas "shall require reasonable further progress (RFP)." In general terms, the goal of these RFP requirements is for areas to achieve generally linear progress toward attainment, as opposed to deferring implementation of all measures until the end; one year prior to the attainment date identified in the SIP.

For areas with an attainment date of 2015 or earlier (i.e., an area that can achieve attainment level emissions during 2014) the attainment demonstration would also be considered to demonstrate that the area is achieving RFP, and there would be no requirement to submit a separate reasonable further progress plan.

For areas with an attainment date beyond 2015 a State is required to submit an RFP plan along with its attainment demonstration and SIP. These plans must demonstrate that generally linear reductions in emissions will occur by 2014, i.e. that emissions in 2014 will be reduced to the extent represented by a generally linear progression from base year emissions (2008) to attainment-level emissions. For any area that needs an extension of the attainment deadline to 2019 or 2020, the State's RFP plan would also need to demonstrate that generally linear reductions will be achieved in the 2017 emissions year as well. The pollutants to be addressed in the RFP plan are those pollutants that are identified as significant for purposes of control measures in the attainment plan.

8.2 RFP for the Salt Lake City, UT Nonattainment Area

The attainment demonstration for the Salt Lake City, UT $PM_{2.5}$ nonattainment area shows that the 24-hr NAAQS will not be achieved with the emission rates representing the year 2019 unless additional reductions in emissions can be identified and implemented by January 1 of that year. Therefore, this SIP identifies and proposes an attainment date of January 1, 2020.

As stated above, a State is required to submit an RFP plan along with its attainment demonstration and SIP for areas with an attainment date beyond 2015. Furthermore, the State's RFP plan would also need to include a demonstration for the 2017 emissions year.

The representation of generally linear progress is based on the notion that reductions in emissions will result in commensurate reductions in $PM_{2.5}$ concentrations. Hence, as described in the regulations, the RFP showing is based on emissions. Nevertheless, EPA acknowledges that $PM_{2.5}$ mitigation also involves a number of attainment plan precursors and that the associated chemistry is non-linear. Thus, States are given some flexibility to adopt any combination of controls of the various pollutants that can be shown to provide equivalent benefits using procedures that EPA is recommending (or at the State's option, air quality modeling).

The RFP plan must demonstrate that in each applicable milestone year, emissions will be at a level consistent with generally linear progress in reducing emissions between the base year and the attainment year.

The base year for the attainment demonstration underlying this plan is 2008. Therefore, the baseline year inventory for the RFP plan will also be 2008.

In keeping with the notion of linear progress, Subpart Z of 40 CFR 51 (at 51.1009) specifies four quantities to be calculated in the RFP plan. These quantities are:

- Full Implementation Reduction, equals: (attainment inventory) – (baseline inventory)
- Milestone Date Fraction, equals: (milestone year – 2008) / (2019 – 2008)
- Benchmark Emission Reduction, and equals: (Full Imp. Reduction – Milestone Date Fraction)
- Benchmark Emission Level equals: (baseline inv.) – (Benchmark Reduction)

Together, these four quantities result in the familiar mathematical equation for a straight line: $y = mx + b$. Without reporting the intermediate results of each of these quantities, Table 8.1 presents this information for emission levels of $PM_{2.5}$ and the attainment plan precursors: NO_x, SO_2, and VOC. For milestone years 2014 and 2017, the values representing straight linear progress are reported under the column heading “rfp”. The other column for that year represents the projected emissions modeled in the attainment demonstration (labeled “projected”).

For the attainment year 2019, the end point to the straight line, there is only one column.

The RFP plan must describe the control measures that provide for meeting the reasonable further progress milestones for the area, the timing of implementation of those measures, and the expected reductions in emissions of direct $PM_{2.5}$ and $PM_{2.5}$ attainment plan precursors. For a discussion of the control measures factored into the attainment demonstration, and hence reflected in the modeled emissions totals (in the “projected” column), see Chapter 6 of the Plan.

Reasonable Further Progress Salt Lake City, UT PM2.5 Nonattainment Area						
***Emissions / Year**	**2008**	**2014**		**2017**		**2019**
		projected	rfp	projected	rfp	
PM2.5	15.9	15.0	13.7	14.5	12.6	11.9
NOx	175.8	144.7	137.1	128.6	117.8	104.9
SO2	13.7	2.0	11.2	10.4	9.9	9.1
VOC	139.9	110.6	116.1	104.5	104.1	96.2
Plan precursors	329.4	257.3	264.4	243.5	231.8	210.2
Total	345.3	272.4	278.1	258.0	244.5	222.1
****Concentration**	45.9	42.6	39.8	40.9	36.8	34.8
* Emissions are presented in tons per average winter day						
**Value for 2008 is Baseline design value for the Hawthorne monitor						

Table 8.1, Reasonable Further Progress Benchmarks for the Salt Lake City, UT Nonattainment Area

The RFP plan must demonstrate that emissions for the milestone year are at levels roughly equivalent to the benchmark emission levels for direct $PM_{2.5}$ emissions and each $PM_{2.5}$ attainment plan precursor to be addressed in the plan.

In addition to the emissions totals, the table also includes the 2008 baseline design value for the controlling monitor (Hawthorne) in the nonattainment area and the predicted $PM_{2.5}$ concentrations for each of the milestones. These concentrations are presented as another metric to establish how much improvement is necessary to meet the 24-hour standard. The RFP rule allows for a generally equivalent improvement in air quality by the milestone year as would be achieved under the benchmark RFP plan, where "equivalence" would make use of the information developed for the attainment plan to assess the relationship between emissions reductions and predicted reductions in $PM_{2.5}$ concentrations.

Motor Vehicle Emissions: 40 CFR 51.1009 also requires that State shall include in its RFP submittal an inventory of on-road mobile source emissions in the nonattainment area. This requirement is for the purposes of establishing motor vehicle emissions budgets for transportation conformity purposes (as required in 40 CFR part 93).

Table 8.2 presents emissions totals for on-road mobile sources. These are the same totals that factor into the overall emissions reported in the preceding RFP table. However, because the geographic extent of the nonattainment area exceeds the urbanized area characterized by the local Metropolitan Planning Organization, these emissions also include contribution from the surrounding rural areas. For a more specific discussion of motor vehicle emissions budgets for transportation conformity purposes, see Chapter 7 of this Plan.

Mobile Source Emissions				
Salt Lake City, UT PM2.5 Nonattainment Area				
***Emissions / Year**	**2008**	**2014**	**2017**	**2019**
****PM2.5**	6.1	4.6	4.1	3.5
NOx	119.0	81.1	68.0	56.1
VOC	70.9	47.3	40.4	33.4
* Emissions are presented in tons per average winter day				
** PM2.5 emissions include: tailpipe PM2.5, SO4, brakewear, and tire-wear				

Table 8.2, Motor Vehicle Emissions for Purposes of RFP

Chapter 9 – CONTINGENCY MEASURES

9.1 Background

Consistent with section 172(c)(9) of the Act, the State must submit in each attainment plan specific contingency measures to be undertaken if the area fails to make reasonable further progress, or fails to attain the $PM_{2.5}$ NAAQS by its attainment date. The contingency measures must take effect without significant further action by the State or EPA.

Nothing in the statute precludes a State from implementing such measures before they are triggered, but the credit for a contingency measure may not be used in either the attainment or reasonable further progress demonstrations.

The SIP should contain trigger mechanisms for the contingency measures, specify a schedule for implementation, and indicate that the measures will be implemented without further action by the State or by EPA.

The CAA does not include the specific level of emission reductions that must be adopted to meet the contingency measures requirement under section 172(c)(9). Nevertheless, in the preamble to the Clean Air Fine Particulate Rule (see 72 FR 20643) EPA recommends that the "emissions reductions anticipated by the contingency measures should be equal to approximately 1 year's worth of emissions reductions necessary to achieve RFP for the area."

9.2 Contingency Measures and Implementation Schedules for the Nonattainment Area

The following measures have been set aside for contingency purposes:

<u>Woodburning Control</u> – No-burn days are presently called at 35 $\mu g/m^3$. By this time the area is already at the 24-hr health standard, and it is likely that air dispersion is very poor. As part of the control strategy for the SIP, rule R307-302 has been amended to change the no-burn call to 25 $\mu g/m^3$. Credit for this change is included in the modeled attainment demonstration as well as the RFP demonstration. However, R307-302 also includes a mechanism to further revise the no-burn call to only 15 $\mu g/m^3$ should a contingency situation arise. The benefit of this rule is to prevent a buildup of particulate matter due to woodsmoke during periods of poor atmospheric mixing which typically precede exceedances of the 24-hour $PM_{2.5}$ NAAQS. This rule has been adopted, and can take effect immediately if so required.

<u>Offset Ratio</u> – Part of the State's permitting program requires that the owner of a new stationary source or an existing stationary source seeking to make a modification must first obtain offsetting emission reduction credits if the proposed increase in emissions rises to certain prescribed levels. Rule R307-422 establishes not only these levels, but also the ratios at which proposed emissions increases must be

offset and the pollutants that would be creditable for such purposes. As part of this contingency plan UDAQ will commit to revising R307-422 with respect to both the offset ratios and the levels used to trigger the requirement. The first milestone for RFP is January 1, 2015, at which time the emissions inventory for 2014 may be assessed. Practically speaking however, the information needed to compile this inventory would not be collected until April 15th of 2015, and then the actual compilation would not be complete until later that year. Given the number of $PM_{2.5}$ plan precursors, it would seem prudent to evaluate the inventory with respect to each of these pollutants (in addition to $PM_{2.5}$) in order to see just how R307-422 might be revised so as to provide the best possible benefit in terms of $PM_{2.5}$ concentrations. Given these considerations, UDAQ will commit to revising R307-422 such that it is effective no later than November of 2015, the beginning of the next winter-time season.

Transportation Control Measures (TCMs) – On-Road Mobile Sources account for most of the NO_x and VOC emissions that lead to fine particulate formation in winter months. The controls affecting on-road mobile sources already accounted for in the attainment and RFP demonstrations are I/M programs and Tier II of the federal motor vehicle control program. Additional control measures are available for contingency purposes, and they fall into the category known as TCMs. The most promising of these measures is Employer Based Trip Reduction during wintertime periods when conditions warrant. It is herein identified as a contingency measure for the purpose of this Plan, with an implementation schedule to be determined.

9.3 Additional Candidates for Contingency

A discussion of the control measures contained in this SIP is included as Chapter 6. Part of that discussion surrounds the need to continue evaluating measures for technical and economic feasibility in light of the emissions reductions still needed for attainment or continued maintenance of the $PM_{2.5}$ NAAQS throughout the nonattainment area. As those measures are evaluated, they may also be considered for use as contingency measures.

9.4 Conclusions

Control measures developed to meet increasingly stringent ozone and fine PM standards in Utah's urbanized areas have likewise become increasingly stringent, and still it is a challenge to attain the 2006 $PM_{2.5}$ NAAQS. This leaves little room for additional reductions that can be set aside as contingency measures.

The control strategy analysis summarized in Chapter 6 shows that stationary sources already meet or exceed RACT, and represent at most about 20% of the emissions contributing to excessive $PM_{2.5}$ concentrations during winter. By contrast, area sources and on-road mobile sources contribute most of the emissions, but further emission control in these categories extends beyond the authorities of UDAQ. The most meaningful reductions in future emissions of VOC, the most important of all the attainment plan precursors, will likely result from additional restrictions of VOC in consumer products, and from what will likely result from Tier III of the federal motor vehicle control program.